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The MS-DOS Device Services Interface

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13. ABSTRACT *(Maximum 200 words)*

Many vendors produce high-performance, low-cost training hardware, but bundle their products with proprietary software interfaces. Because these interfaces are proprietary, courseware and authoring systems written to operate on one set of hardware will not run on a competitor's hardware. Expensive reprogramming is needed to adapt to new hardware. These reprogramming costs can be eliminated by adopting standard software interfaces. The objectives of this effort were to describe and develop a standard software interface that will allow training systems to be assembled from separate "plug-and-play" components in the same way that stereo systems can be assembled from separate speakers, amplifiers, and other components. The Portable Courseware (PORTCO) architecture consists of two interfaces, the Device Services Interface and the Device Handler Interface. It also contains three layers: application, routing and configuration, and the device handler. This architecture should allow applications software to run on any compliant set of hardware components. The series of reports describing the PORTCO architecture should direct development of portable MS-DOS applications and standard peripheral device handlers. This report describes the MS-DOS Device Services Interface, and is intended primarily for programmers who want to develop portable application software.

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Foreword

This document describes the device services interface, a component of an architecture for interactive courseware delivery systems. It was developed under the sponsorship of the Office of Secretary of Defense (Force Management and Personnel). Mr. Gary Boycan was the technical sponsor. Funding was provided under Program Element 0604722J, Work Unit 99-PJ1-90-006.

This document was developed under the technical supervision of Dr. Raye Newmen, Dr. Wallace H. Wulfeck, and Mr. Walter F. Thode of the Navy Personnel Research and Development Center (NPRDC). This report itself was written by Systems Engineering Associates under Contract N66001-88-D-0054, Delivery Order 7J30.

This architecture was developed as part of an effort to complete a reference implementation of a courseware portability specification. The implementation is scheduled for later this year. Comments on the architecture described here are solicited from all interested parties. The specification will then be submitted for consideration for official adoption by the Department of Defense and the National Institute of Standards and Technology.

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Summary

Background

Over the next several years the Federal Government will invest millions of dollars to develop training materials for delivery on computer-based interactive training systems. To support this investment, Federal agencies will acquire a variety of computers and peripheral devices. This hardware will host several operating systems and authoring system software to speed courseware development.

Many vendors produce high-performance, low-cost training hardware, but bundle their products with proprietary software interfaces. Because these interfaces are proprietary, courseware and authoring systems written to operate on one set of hardware will not run on a competitor's hardware. Expensive reprogramming is needed to adapt to new hardware. These reprogramming costs can be eliminated by adopting standard software interfaces.

Objectives

The objectives of this effort were to describe and develop a standard software interface that will allow training systems to be assembled from separate "plug-and-play" components in the same way that stereo systems can be assembled from separate speakers, amplifiers, and other components.

Approach

The Portable Courseware (PORTCO) architecture consists of two interfaces, the Device Services Interface and the Device Handler Interface. It also contains three layers: application, routing and configuration, and the device handler. This architecture should allow applications software to run on any compliant set of hardware components.

Results and Conclusions

This report is the second in a series of five reports; it describes the MS-DOS Device Services Interface and is intended primarily for programmers who want to develop portable application software. The first report provides an overview of the PORTCO architecture and should be of interest to all who are concerned with computer-based training. The third report describes the Device Handler Interface and should be of primary interest to device manufacturers and system vendors who must develop device handler software. The fourth report is intended for system vendors and describes the design

of the first PORTCO routing and confirmation program. The fifth report is intended as additional support for those who must develop complaint MS-DOS device handler.

Recommendations

1. The reports describing the PORTCO architecture should direct development of portable MS-DOS applications and standard peripheral device handlers.

2. The architecture should serve as a foundation for compliance with the Interactive Video Industry Association's "Recommended Practices for Interactive Video Portability." The architecture should motivate development of specific applications and device handlers that adhere to this specification.

3. Feedback about problems and suggested improvements should be forwarded to the Navy Personnel Research and Development Center, Code 152.

Table of Contents

List of Tables

List of Figures

1. Purpose and Scope

This document describes the DSI, the boundary between the *Application* and the *Routing and Configuration (R&C) layers* of the PORTCO architecture. It is a primary reference for application developers who use the DSI to control *peripheral devices*, and for system administrators who configure and maintain courseware delivery systems. It also provides helpful background information for developers of R&C-layer software and PORTCO device handlers. This is one of several documents, listed in Table 1, describing the PORTCO architecture in an MS-DOS[1] environment.

Table 1
This specification is one of a collection of POFTCO documents.

Title	Description
A Portable Courseware Architecture (Thomason, Van de Wetering, & Booth, 1990)	A top-level description of the PORTCO architecture.
The MS-DOS Device Services Interface (This report)	A specification for the MS-DOS interface between the PORTCO architecture's Application layer and its R&C layer. This specification guides the development of compliant applications and compliant R&C programs.
The MS-DOS Device Handler Interface (Van de Wetering & Thomason, 1990)	A specification for the MS-DOS interface between the PORTCO architecture's R&C layer and its Device Handler layer. This specification guides development of compliant MS-DOS device handlers and compliant MS-DOS R&C programs.
MS-DOS Routing and Configuration Program Design (Van de Wetering & Thomason, 1990)	A specification for the first implementation of compliant MS-DOS R&C-layer software, expected to serve as an example for future implementations.
Guidelines for Implementing MS-DOS Device Handlers (Van de Wetering & Thomason, in preparation)	A collection of informal guidelines and examples to support the development of compliant MS-DOS device handlers.

All readers should be familiar with *A Portable Courseware Architecture* (Thomason & Van de Wetering, 1990), the first publication listed in Table 1. Application developers should be fluent in at least one programming

[1] MS-DOS is a registered trademark of Microsoft Corporation.

language (preferably "C") and should understand the invocation of software interrupts and *interrupt service routines (ISRs)*. System administrators should be: (1) capable of connecting peripheral devices (videodisc players, mice, etc.) to their MS-DOS computers, (2) able to create and update ASCII text files, and (3) able to invoke executable programs from the MS-DOS command line. Developers of R&C-layer software and PORTCO device handlers should be accomplished MS-DOS system programmers with a sound understanding of "C," MS-DOS system services, and assembly language.

Each reader, depending on his particular interests, will find certain sections of this document to be of special importance (although all readers should benefit from a review of the complete document). Table 2 highlights sections of special interest to each type of reader, and Table 3 highlights the location of answers to common questions.

Table 2 *Different document sections will be of interest to different readers.*

APPLICATION DEVELOPERS	SYSTEM ADMINISTRATORS	R&C LAYER DEVELOPERS	DEVICE HANDLER DEVELOPERS		SECTION
X	X	X	X	1	Purpose and Scope
X	X	X	X	2	Background
X	X	X	X	3	Initialization
X	X	X	X	4	Configuration File
X		X		5	Packets
X			X	6	Services and Logical Devices
X	X	X	X	7	Glossary
X	X	X	X	8	References
X		X		A	R&C Services
X			X	B-D	Logical Device Services

Table 3
Reader's questions are answered in various sections.

Section References	Application Developers' Questions
5.2, 5.3	How do I create packets?
5.1	How do I send and receive packets?
3, 4.1, 5.1	What interrupts do I use to send and receive packets?
5.1, Appendices A-E	What are the DSI's calling conventions?
5.1, Appendices A-E	How do I write a programming language binding to the DSI?
3	How do I sense the DSI's presence?
3, Appendix A	How do I know that all the devices I need are present?
3, Appendix A	How do I know that all the device features I need are present?
3, 5.1, 5.3	How do I use alerts?
3, 5.1	What do I do if I do not want to use alerts?

Section References	System Administrators' Questions
3, 4	How do I install and activate the DSI?

2. Background

Figure 1 illustrates the PORTCO architecture and the DSI's position within it. Each layer of the PORTCO architecture communicates only with its adjacent layers. DSI services are provided to applications (and to *DSI toolbox* components) exclusively by the R&C layer. This layer is implemented as an MS-DOS *TSR program*, named the R&C program. Because the R&C program performs all of the R&C layer's functions, the rest of this document discusses the R&C program, rather than the R&C layer.

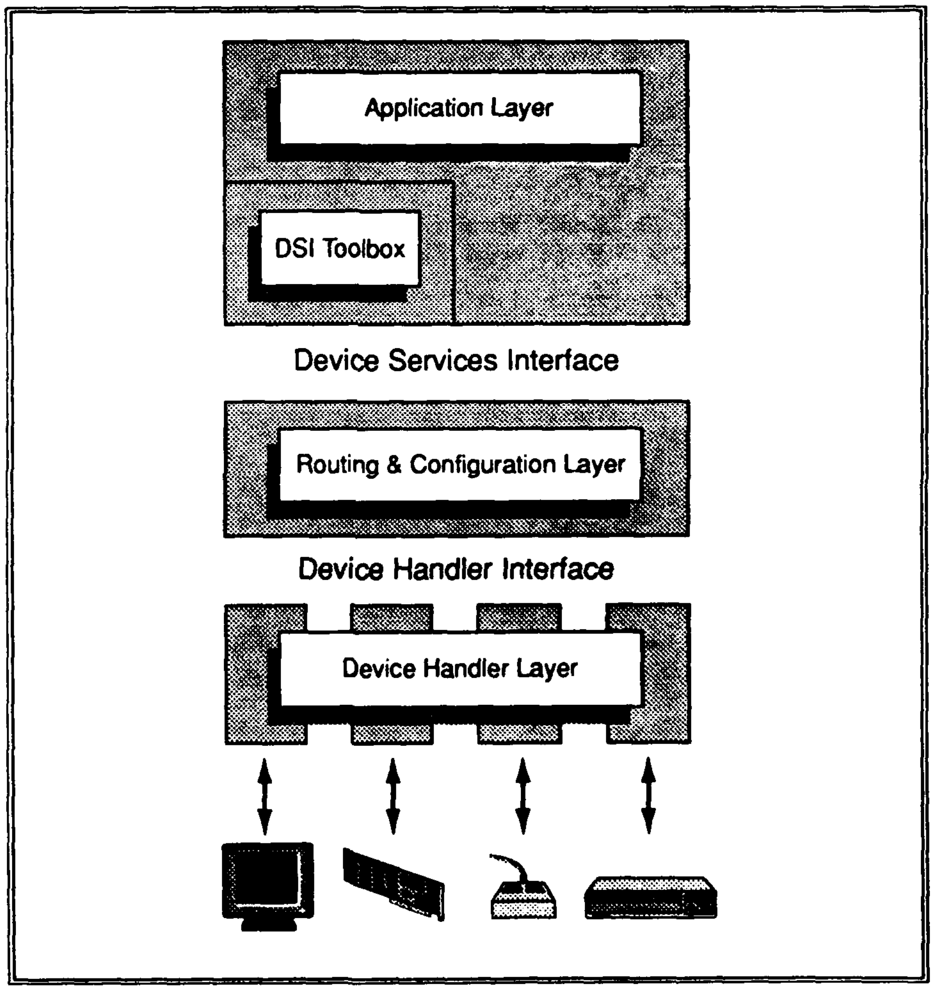


Figure 1 *The PORTCO architecture contains three layers and two interfaces.*

To activate the DSI, an MS-DOS computer must first execute the R&C program. This can be done automatically from a batch file (e.g., AUTOEXEC.BAT) or interactively from the system's command line. As described in Section 3, the R&C program immediately loads and initializes the system's device handlers, then returns control to the operating system, leaving two resident interrupt service routines. (A DSI configuration file, described in Section 4, directs the loading of DSI device handlers in much the same way that CONFIG.SYS directs the loading of

MS-DOS device drivers.) Thereafter, applications exchange *packets* with the R&C program using two software interrupts: one to pass packets to the program and one to receive packets from it. To deactivate the DSI, an application may invoke the interface's termination service, as described in Appendix A.

Most DSI services allow applications to control *logical devices*. These services are performed by PORTCO device handlers; the R&C program merely routes requests for the services from an application to the appropriate handler (as described in *A Portable Courseware Architecture* (Thomason & Van de Wetering, 1990), listed in Table 1). Logical device services are specified in Appendices B through E. Two other DSI services allow applications to determine the system's peripheral configuration and to terminate the interface. These services are performed directly by the R&C program, and are described in Appendix A.

3. Initialization

When invoked from the MS-DOS command line, the R&C program immediately initializes the DSI. An ASCII text file, called the DSI configuration file, provides information to guide the initialization process. This file, typically created and maintained by a system administrator, is updated when the system's hardware or *application software* changes. It contains entries that identify the software interrupts used to pass packets, as well as entries that identify the system's logical devices and active device handlers. Section 4 describes this file in detail.

To initialize the DSI, the R&C program:

- Loads each device handler specified in the configuration file into MS-DOS's RAM address space.
- Associates each logical device with a device handler entry point, as specified in the configuration file.
- Initializes each device handler using DHI service 0, "Initialize Device Handler," and data from the configuration file's device specification records. (Van de Wetering and Thomason (1990) describes DHI services.)
- Saves the current request interrupt vector and loads it with an *interrupt* service routine that routes packets to device handlers.
- Saves the current alert interrupt vector and loads it with an interrupt service routine that does nothing.
- Loads interrupt vector 12h with an interrupt service routine that reports the values of the alert and request interrupts when the ES:DX registers contain the address of the null-terminated string, "PORTCO_APPLICATION". This ISR must be installed so that normal requests for memory size are passed to the previous ISR for interrupt 12h.

The R&C program signifies successful initialization by returning control to MS-DOS and displaying a message describing condition 0 (see Table 4) on the system's standard output. (Device handlers and R&C-program ISRs remain in memory at this time.) The R&C program signifies unsuccessful completion by displaying a message describing one (or more) of conditions 1 through 11 listed in Table 4.

An application can be sure that the DSI is active by placing the address of the null-terminated string, "PORTCO_APPLICATION," into the ES:DX registers and issuing interrupt 12h. When the interrupt returns, the string will be overwritten by the hexadecimal values of the request and alert interrupts, separated and terminated by single blank characters (e.g., a return value of "69 6A " specifies a request interrupt of 69 hex and an alert interrupt of 6A hex). If the DSI has not been successfully initialized or is not present, the string will be unaltered when the interrupt returns. To determine the system's logical device configuration and the services offered by each device, the application should invoke R&C service 0, "Configuration Status Query," followed by service 2, "Services Query," for each device. These services are described in Appendices A through E.

Table 4
The R&C program displays messages on the system console.

0	Initialization successful
1	Configuration file missing
2	Configuration file syntax error
3	Interrupt out of range
4	Request and event interrupt identical
5	Invalid device class
6	Device number out of range
7	Duplicate device number
8	Cannot find device handler
9	Insufficient memory
10	Device handler reports fatal error during initialization
11	Device handler file does not contain device handler identification stamp

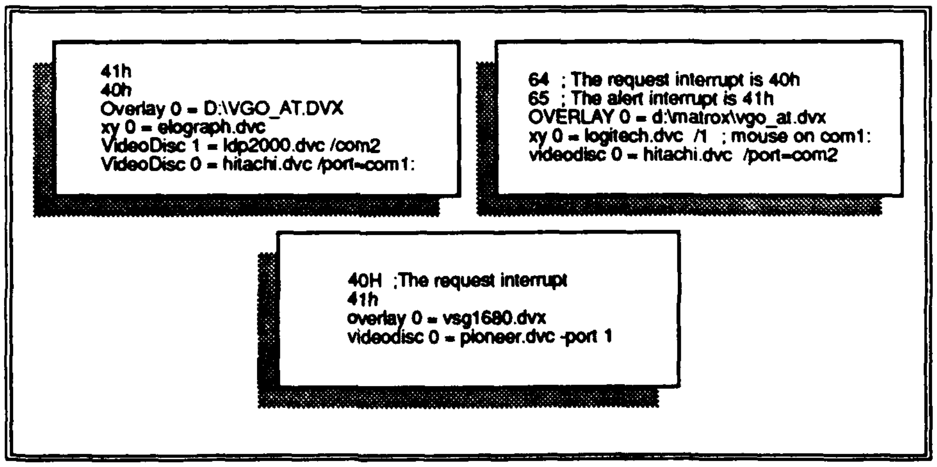
To use alerts, applications must attach an appropriate ISR to the alert interrupt, then use service 3, "Set Alert Mask," to enable particular alerts. Because all alerts are initially disabled, applications need take no action to ignore alerts. ISRs that process alerts should not invoke non-reentrant system services (e.g., DOS services).

4. Configuration File

The DSI configuration file directs the DSI's initialization and assigns a system's logical devices to its physical peripherals. This file is created and maintained by the system's administrator and is used by the R&C program.

The DSI configuration file is an ASCII text file. Each record in this file is a line terminated with a carriage return and a linefeed character. Within a record, fields are separated by at least one space or tab character. Fields may be separated by more than one of these characters or by any combination of space and tab characters. Comments may be inserted into the configuration file by preceding them with a semicolon character (";"). The remainder of a line following a semicolon is considered a comment. Blank lines and lines containing only spaces and tabs and semicolon-delimited comments are also considered comments, and are called comment records. Alphabetic characters in the DSI configuration file may be either uppercase or lowercase. No record in this file may be more than 256 characters long.

The name of the DSI configuration file is CONFIG.DSI. The R&C program first looks for this file in the current working directory; if the file is not there, the R&C program searches for it in the directories listed in MS-DOS's "path" environment variable. Figure 2 shows examples of typical configuration files.



```
41h
40h
Overlay 0 = D:\VGO_AT.DVX
xy 0 = elograph.dvc
VideoDisc 1 = ldp2000.dvc /com2
VideoDisc 0 = hitachi.dvc /port=com1:
```

```
64  ; The request interrupt is 40h
65  ; The alert interrupt is 41h
OVERLAY 0 = d:\matrox\vgo_at.dvx
xy 0 = logitech.dvc  /1   ; mouse on com1:
videodisc 0 = hitachi.dvc  /port=com2
```

```
40H  ;The request interrupt
41h
overlay 0 = vsg1680.dvx
videodisc 0 = pioneer.dvc -port 1
```

Figure 2
A configuration file directs the DSI's initialization.

4.1 Interrupt Specification Records

The first two DSI configuration file records specify the software interrupts used by application programs to exchange packets with the R&C program (packets are discussed in Section 5). The first record specifies the request interrupt and the second specifies the alert interrupt. These two interrupt numbers cannot be the same. Each of these two records contains a single field with at most three letters or digits. The interrupts may be specified in either decimal or hexadecimal format. Hexadecimal entries must end with the letter "h." Entries without a trailing "h" are interpreted as decimal numbers. All entries are interpreted without regard to case. All entries must be in the range from 64 (40h) to 255 (FFh). Figure 3 illustrates both valid and invalid interrupt specifications.

Figure 3
All interrupt specifications must range from 64 to 255.

```
70      ; Valid decimal specification.
47h     ; Valid hex specification.
60      ; Invalid decimal spec: out of range.
60H     ; Valid hex specification.
```

4.2 Device Specification Records

The configuration file's remaining non-comment records are called device specification records, and list the system's logical devices and device handlers. Each record contains the specification for one logical device. The first field in a device specification record contains a string identifying a *device class*, as illustrated in Table 5. These strings are interpreted without regard to case.

Table 5
A case-insensitive string identifies each device class.

Device Class	Device Class String
Videodisc Player	Videodisc
Video/Graphics Overlay	Overlay
Locator	Locator
Audio Management	Audio

The second field contains a decimal number (in the range 0 to 255) to identify a particular device within a class. This field is optional; if omitted, the R&C program assumes a device number of 0.

An equal sign ("=") follows the device number in each device specification record. If the device number is omitted, the equal sign follows the device class string.

The filename of a device handler is the next field in the record. This field may be either a simple filename or a pathname. If it is a simple filename, the R&C program first looks for the file in the current working directory, then in the directories listed in MS-DOS's "path" environment variable. If the field contains a pathname, the R&C program first looks in the specified directory, then in the current working directory, and finally in the directories listed in the "path" environment variable. Figure 4 illustrates examples of this record.

Figure 4
A device handler file specification may be either an MS-DOS filename or a pathname.

```
HITACHI.DVC
C:\PORTCO\HANDLERS\LDP2000.DVC
NMG_VW.DVX
D:\MATROX\VGO_AT.DVX
\PORTCO\VGO_AT.DVX
```

All characters following the device handler filename (and preceding any comment character) are passed unchanged to the device handler when the R&C program issues DHI service 0, "Initialize Device Handler" (see Section 3). These characters supply initialization information to the device handler. Their syntax and semantics are dictated by device handler authors. For example, a particular videodisc player handler might use the following parameter to determine which communication port to use:

```
/PORT=COM1:
```

5. Packets

Applications communicate with the R&C program using contiguous blocks of data called packets. Applications pass packets to the R&C program to request service from logical devices, and the R&C program passes packets to applications to alert them to asynchronous device activity. *Request packets* solicit services, and *alert packets* announce device activity.

5.1 Packet Routing

Applications pass request packets to the R&C program by putting the packet's 32-bit address[2] in the ES:DX *registers*, then invoking a software interrupt. The R&C program passes alert packets to applications in the same way, using a different software interrupt. Figure 5 illustrates this packet-passing convention.

An application obtains the values of the interrupts used to pass packets by placing the address of the null-terminated string, "PORTCO_APPLICATION," into the ES:DX registers and issuing interrupt 12h. When the interrupt returns, the string will be overwritten by the hexadecimal values of the request and alert interrupts, separated and terminated by a single blank character; the request interrupt is the first number and the alert interrupt is the second. For example, upon return from interrupt 12h the string might contain "5d 5c", identifying interrupt 5d (hex) as the request interrupt and 5c (hex) as the alert interrupt (alphabetic characters in this returned string may be either uppercase or lowercase).

To pass request packets to the R&C program, the application places the packet's 32-bit address into the ES:DX registers and issues the request interrupt. The R&C program's request ISR saves any registers that it uses and restores them before returning to the application.

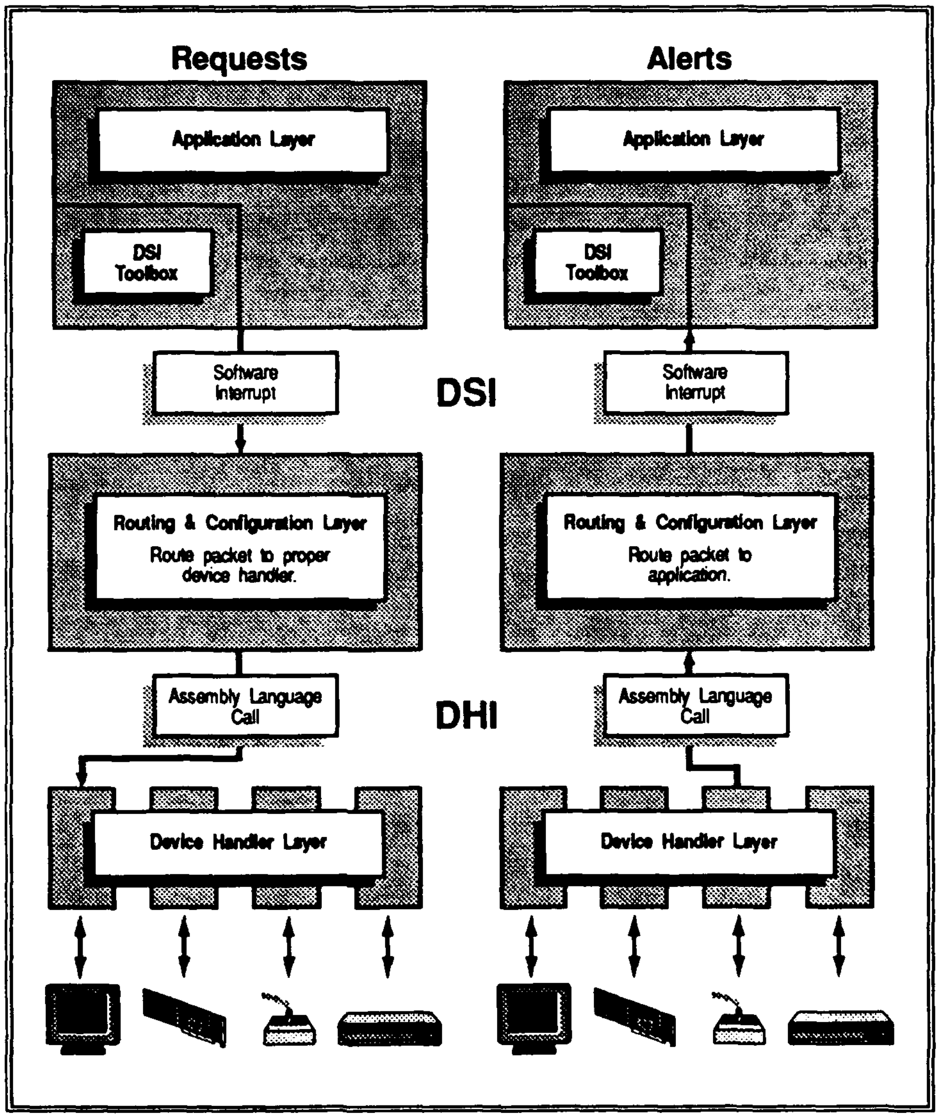
To receive alert packets, applications must attach an ISR to the alert interrupt; to receive request packets, the R&C program attaches an ISR to the request interrupt. Applications that do not want to receive alerts should not attach an ISR to the alert interrupt (the R&C program initially disables all alerts).

To pass alert packets to the application, the R&C program places the packet's 32-bit address into the ES:DX registers and issues the alert interrupt. Before issuing the interrupt, the R&C program restores the application's stack (SS:SP) if it is not currently active. (The application's

[2] All 32-bit addresses in this document are formatted using a standard 80x86 16-bit *segment* followed by a 16-bit offset.

stack might not be active if the alert interrupted the R&C program or a device handler.) The application's alert ISR must save and restore any registers it uses. Because alerts are generated by hardware interrupts, the application's alert ISR is really part of a hardware ISR and should behave accordingly (e.g. no loops, no excessive work, no wasted time, no DOS calls).

Figure 5
Packets are used to solicit services and issue alerts.

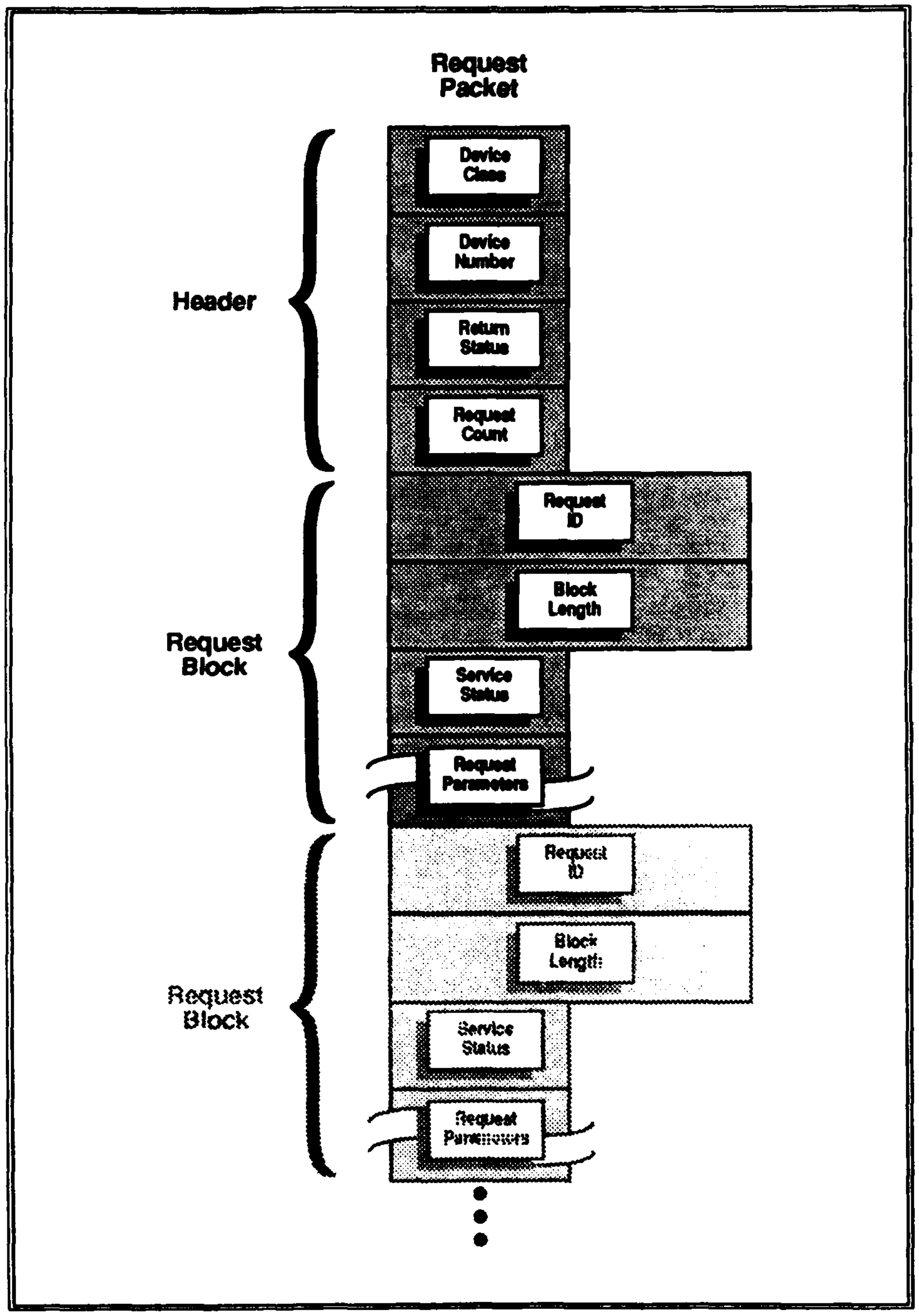


5.2 Request Packets

Figure 6 illustrates a request packet. As this figure suggests, each packet consists of a header followed by a series of request blocks, and each packet may contain a sequence of requests.

The device class is the first packet field; it occupies one byte and is set by the application, using Table 6. (Data in all fields are formatted as unsigned integers unless otherwise specified.) The device number is the second field; it also occupies one byte and is set by the application. These two fields identify a logical device, the packet's destination (e.g., videodisc player 2).

Figure 6
A request packet contains a header and one or more request blocks.



The return status is the packet's third field; it occupies one byte and is set by the device handler to indicate successful completion of the packet's services. Zero here indicates success and a non-zero value indicates failure. When this field is non-zero, its value identifies the first request that failed. For example, if the packet's fifth request failed, this field would be 5. (Requests in the same packet following a failed request are not processed.) The header's final field is the request count; it occupies one byte, is set by the application, and indicates the number of requests contained in the rest of the packet.

Table 6
An unsigned, 8-bit integer identifies each device class.

Device Class	Value
Videodisc Player	0
Video/Graphics Overlay	1
Locator	2
Audio Management	3

Each request block begins with a field to identify its service. This field occupies two bytes and is set by the application. Services for each logical device are labeled with a unique integer, which is used in this field. As examples, Table 7 lists a few videodisc player services and their identification numbers. Section 6 lists all DSI services.

Table 7
DSI services have integer labels.

Name	Service ID
Services Query	2
Set Alert Mask	3
Disable All Alerts	4
Player Status	5
Videodisc Status	6
Position Request	7
Spin Up/Down	8
Eject	9
Frame Search	10
Jump	11
Still	12
Chapter Search	13

The next request-block field occupies two bytes and is set by the application to indicate the number of bytes in the block. This byte count should include the block's two-byte service identification.

The next field occupies one byte and is set by the device handler to indicate the service's success or failure. A zero value here indicates success, and a non-zero error code indicates failure. Each logical device uses a unique set of error codes. As examples, Table 8 lists some codes used by the logical videodisc player. Other error codes are listed in Section 6.

Service parameters make up the request block's remaining fields. The number and content of these fields vary with each request. For example, Figure 7 illustrates a request block for videodisc player's service 10, "Frame Search." All parameters in this case are set by the application. Figure 8 shows the request block for service 5, "Player Status." Parameters in this case are set by the device handler, and the block's status field indicates the handler's success at providing the requested information. (If a request for videodisc player status failed because the videodisc player was disconnected and did not respond, the status field would report this error, indicating to the application that the information returned was invalid.) Appendices A through E detail the service parameters of all DSI services.

Table 8
Each PORTCO device uses integer error codes.

Description	Error Code
Service successful	0
Unknown error	1
Device not available	2
Device handler busy	3
Player not responding	4
Player busy	5
Videodisc parked	6
Ejected	7
No videodisc in player	8
Invalid frame number	9
Invalid chapter number	10
Invalid jump offset	11
Chapters not available	12
Destination unreachable	13
Invalid speed selection	14
Player already at first frame	15
Player already at last frame	16
Remote control not present	17
Interrupted before completion	18
Already initialized	19
Must open with front panel	20
Player spun down	21

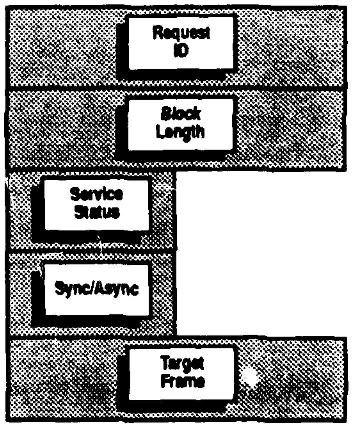
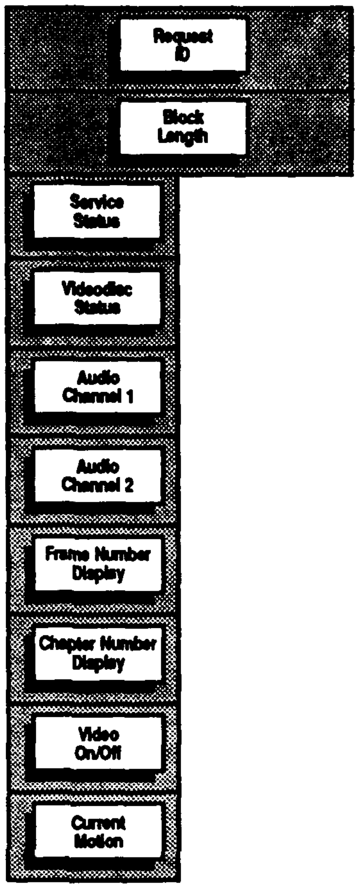


Figure 7
Request block parameters vary with each service as indicated by this request block for "Frame Search."

Figure 8
Request block parameters vary with each service, as indicated by this request block for "Player Status."



5.3 Alert Packets

As illustrated in Figure 9, an alert packet consists of a header followed by a series of alert blocks. Like a request packet, each alert packet may contain multiple alerts. All fields in this packet are set by device handlers and read by applications, and all fields are formatted as unsigned integers unless otherwise specified.

The device class is the packet's first field and occupies one byte. The device number is its second field and also occupies one byte. Together, these fields identify the logical device issuing the alert. The packet's third field, the alert count, occupies one byte. This field indicates the number of blocks in the rest of the packet.

An alert block's first field occupies two bytes and identifies a device activity. For example, Table 9 lists activities reported by a logical locator device. Section 6 and Appendices B through D describe alerts issued by all PORTCO logical devices.

Figure 9
Each alert packet communicates one or more alerts.

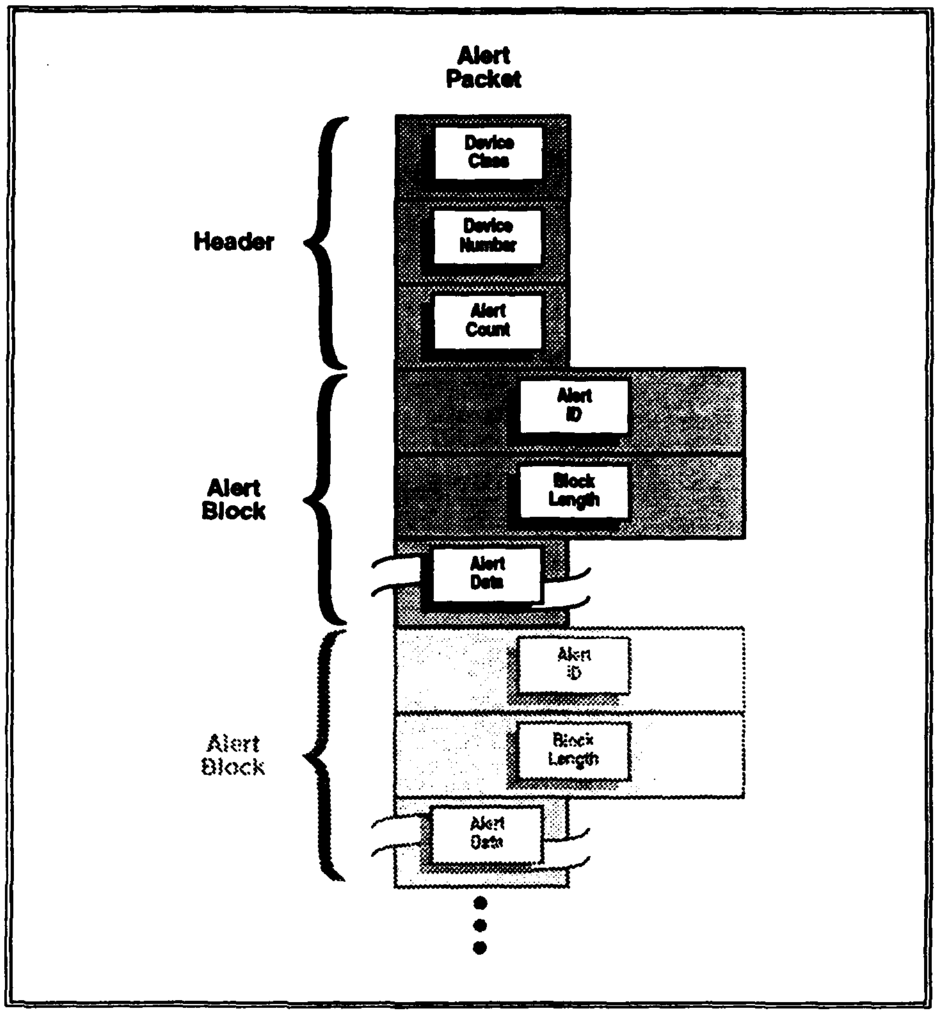
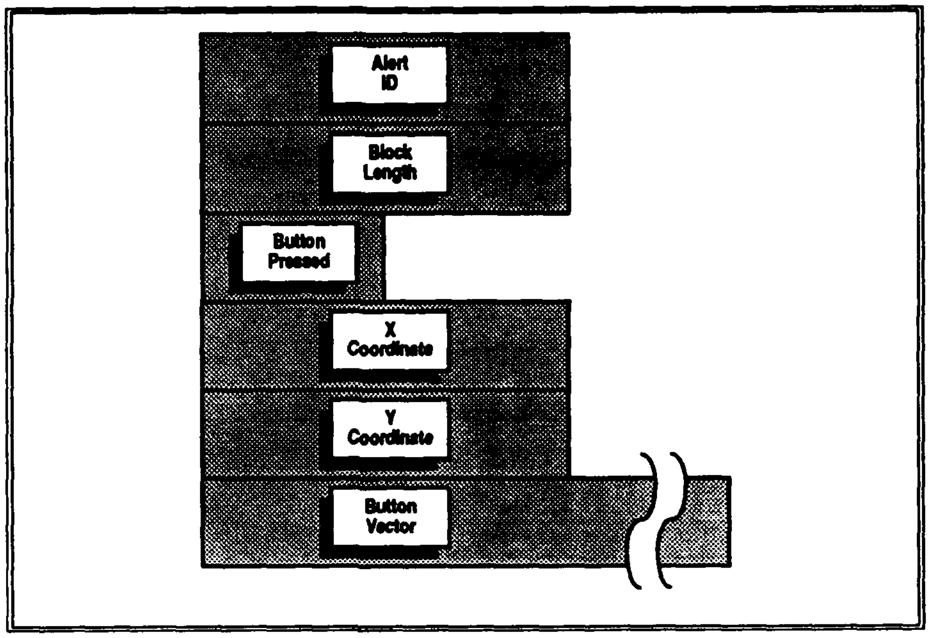


Table 9
A logical locator provides three alerts.

Name	Identification
Movement	0
Button Pressed	1
Button Released	2

An alert block's second field describes the number of bytes in the block (including the first two alert-ID bytes). Alert data make up the remaining fields in an alert block. The number and size of these fields depend on the alert being issued. For example, Figure 10 illustrates this block for the "Locator Button Pressed" alert. Appendices B through D describe these fields for all DSI alerts.

Figure 10
Alert block data vary with each alert.



6. Services and Logical Devices

The DSI provides services for each logical device listed in Table 5 (page 9). These services are actually performed by device handlers, but their requests and alerts pass through the R&C program according to the conventions detailed in Section 5. Table 10 lists services common to all logical devices. These and all other logical device services are presented in Appendices B through E. Two additional DSI services that are performed directly by the R&C program are specified in Appendix A.

Table 10
The first three services in each device class are identical.

Name	Identification
Query Services	2
Set Alert Mask	3
Disable All Alerts	4

Some services may be executed synchronously or asynchronously. When a service is executed synchronously, control returns to the application when the service finishes. When a service is executed asynchronously, control returns as soon as the service is initiated. An alert is issued later when the service is finished.

As suggested by Van de Wetering and Thomason (1990), logical devices are fashioned from characteristics shared by several physical peripherals. The following sections present the conceptual models underlying each logical device and list all services each offers.

6.1 Videodisc Player

A logical videodisc player presents motion video, still video, and audio output from a prerecorded source, under the control of computer software. A video frame is a single, still video picture that is labeled with an integer between 1 and 54,000 called a frame number. A logical videodisc player produces video and audio output in the modes presented in Table 11.

A logical videodisc player randomly accesses up to 54,000 frames of video information and provides two audio channels. Depending on the prerecorded source, the audio channels may make up a single stereo channel or may contain distinct audio tracks. The audio channels and the video output may be synchronized to produce television-like output. In addition to being controlled by computer software, a videodisc player may have a remote control unit or front-panel controls, allowing a user to control the device directly without a computer. Most videodisc players read prerecorded video and audio information from LaserVision format optical disks. These disks can be recorded in both Constant Linear

Velocity (CLV) and Constant Angular Velocity (CAV) formats. CLV format disks typically do not allow random access to individual frames of video and so will not support most of the services in this device class.

Table 11
A logical videodisc player has nine operating modes.

Mode	Description
Still	Presents a single still video picture. No audio is produced in this mode.
Normal forward	Presents motion video at approximately 30 frames per second, displaying frames in increasing numerical order. Audio is produced in this mode.
Slow forward	Presents motion video at between 1/4 and 3/4 of normal-speed motion, displaying frames in increasing numerical order. No audio is produced in this mode.
Fast forward	Presents motion video at between 2 and 4 times normal-speed motion, displaying frames in increasing numerical order. No audio is produced in this mode.
Scan forward	Presents motion video as fast as possible, displaying frames in increasing numerical order. No audio is produced in this mode.
Normal reverse	Presents motion video at approximately 30 frames per second, displaying frames in decreasing numerical order. No audio is produced in this mode.
Slow reverse	Presents motion video at between 1/4 and 3/4 of normal-speed motion, displaying frames in decreasing numerical order. No audio is produced in this mode.
Fast reverse	Presents motion video at between 2 and 4 times normal-speed motion, displaying frames in decreasing numerical order. No audio is produced in this mode.
Scan reverse	Presents motion video as fast as possible, displaying frames in decreasing numerical order. No audio is produced in this mode.

Table 12 lists all videodisc player services and the page in this document where they are specified; Table 13 lists all alerts; and Table 14 lists all of the error codes returned by videodisc player services.

Table 12
A logical videodisc player provides 23 core services.

Name	Service ID	Core/Extended	Page[a]
Services Query	2	Core	B-1
Set Alert Mask	3	Core	B-2
Disable All Alerts	4	Core	B-2
Player Status	5	Core	B-3
Videodisc Status	6	Core	B-4
Position Request	7	Core	B-5
Spin Up/Down	8	Core	B-6
Eject	9	Core	B-7
Frame Search	10	Core	B-8
Jump	11	Core	B-9
Still	12	Core	B-10
Chapter Search	13	Core	B-11
Video On/Off	14	Core	B-12
Audio1 On/Off	15	Core	B-13
Audio2 On/Off	16	Core	B-13
Set Stop	17	Core	B-14
Set Inform Flag	18	Core	B-15
Remote Control On/Off	19	Core	B-16
Frame Display On/Off	20	Core	B-17
Chapter Display On/Off	21	Core	B-17
Chapter Play	22	Core	B-18
Motion	23	Core	B-19
Service Status Query	24	Core	B-20

[a] Pages appear in Appendix B of this publication.

Table 13
A logical videodisc player provides two alerts.

Name	Alert ID	Core/Extended	Page[a]
Service Complete	0	Core	B-21
Frame Arrival	1	Core	B-21

[a] Pages appear in Appendix B of this publication.

Table 14
A logical videodisc player provides 22 error codes.

Description	Error Code
Service successful	0
Unknown error	1
Device not available	2
Device handler busy	3
Player not responding	4
Player busy	5
Videodisc parked	6
Ejected	7
No videodisc in player	8
Invalid frame number	9
Invalid chapter number	10
Invalid jump offset	11
Chapters not available	12
Destination unreachable	13
Invalid speed selection	14
Player already at first frame	15
Player already at last frame	16
Remote control not present	17
Interrupted before completion	18
Already initialized	19
Must open with front panel	20
Player spun down	21

6.2 Locator

A locator is a logical device that reports two-dimensional position information. A locator reports its position as a pair of integers, called an X-coordinate and a Y-coordinate. These coordinates describe the locator's distance from two stationary, intersecting, perpendicular lines, called the X and Y axes. The point where the axes intersect is called the origin and has the coordinates (0, 0). Coordinate values on each axis can range from 32767 to -32768. Figure 11 illustrates a logical locator's coordinate system.

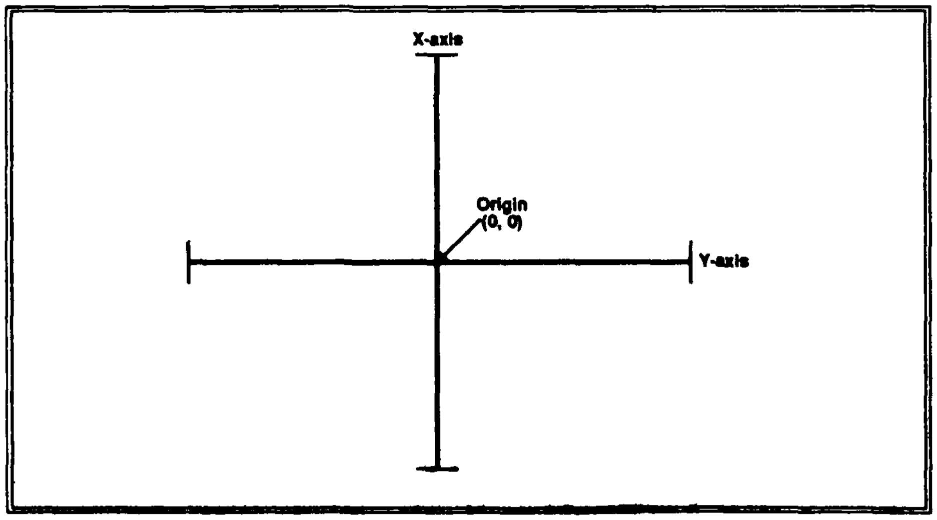


Figure 11
A logical locator uses a Cartesian coordinate system.

A locator may also report the state of from 0 to 256 logical buttons. Each button is labeled with an integer between 0 and 255, and a locator reports each button state as a binary value, pressed (1) or released (0). Each button state is represented as a bit within a bit-vector[3] (see Figure 12). This bit vector is called the locator's button vector. The N'th bit in a locator's button vector represents the state of its N'th button. Figure 13 illustrates a locator's button vector.

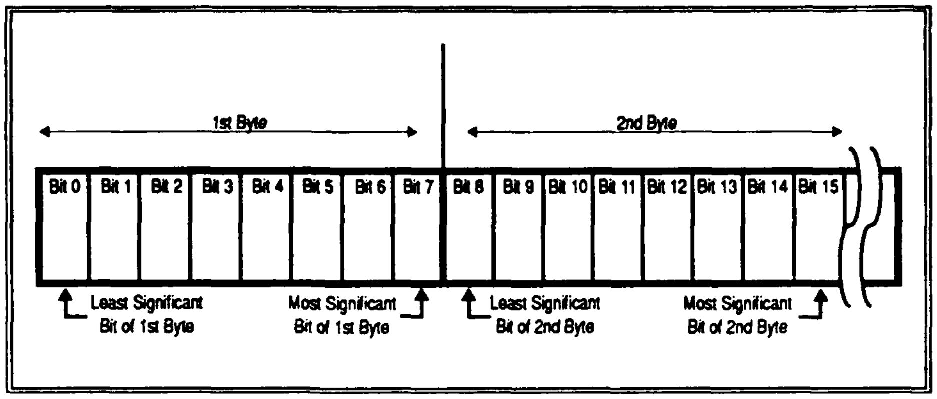

1st Byte
2nd Byte
Bit 0
Bit 1
Bit 2
Bit 3
Bit 4
Bit 5
Bit 6
Bit 7
Bit 8
Bit 9
Bit 10
Bit 11
Bit 12
Bit 13
Bit 14
Bit 15
Least Significant Bit of 1st Byte
Most Significant Bit of 1st Byte
Least Significant Bit of 2nd Byte
Most Significant Bit of 2nd Byte

Figure 12
A bit-vector is a sequence of contiguous bits terminated at a byte boundary.

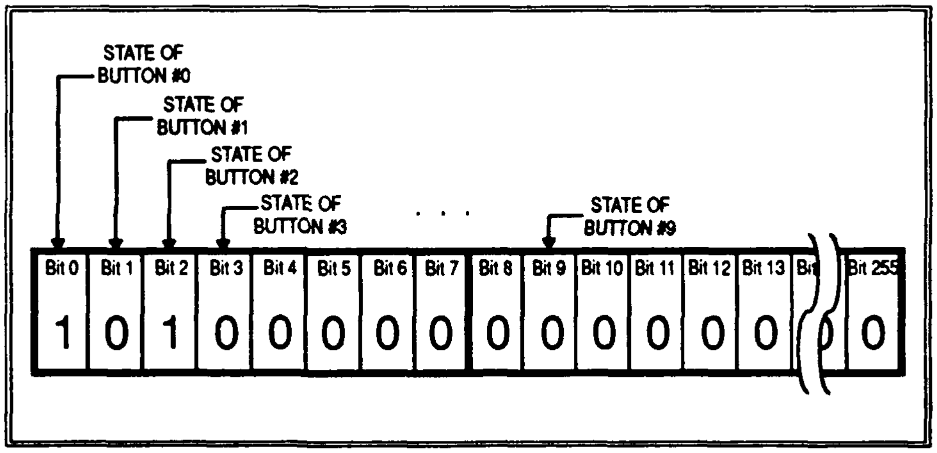


Figure 13
A locator's button vector reports the state of up to 256 logical buttons.

A locator's services can be performed by several peripherals, including mice, touchpanels, graphics tablets, light pens, track balls, joy sticks, and keyboards. Many do not have physical buttons, and some do not have native coordinate systems with stationary, intersecting, perpendicular axes. When used as locators, these peripherals' device handlers must translate their native position and state information into the coordinate system and button vector described above.

For example, most touchpanels have no buttons but can sense the presence or absence of a touch on their surface. When used as a locator, a touchpanel's device handler should use button 0 to report touch activity. Most mice report their position using a native coordinate system whose

[3] A bit-vector is a string of consecutive bytes whose bits are labeled sequentially from the least significant bit of the first byte to the most significant bit of the last byte. The first bit is labeled 0, the second is labeled 1, etc. Figure 12 illustrates the format of a bit-vector.

origin moves with them: Changes in position are reported as a distance from the mouse's last position, not as a distance from a fixed origin. When used as a locator, a mouse's device handler should maintain a fixed coordinate system and map its peripheral's native coordinates into this fixed system. To help guide the implementation of locator device handlers, and to ensure compatibility among different peripherals, Van de Wetering and Thomason (1990) presents the conventions used to implement common peripherals as locators.

Locators are often used to let operators select graphic objects or locations on a display device. When used for this purpose, a peripheral may allow direct or indirect interaction with the screen. Direct interaction occurs if the plane of the peripheral's native coordinate system is physically coincident with the display, and indirect interaction occurs if these planes are not physically coincident. For example, a touchpanel and a light pen both allow direct interaction: Their native coordinate systems are physically coincident with the screen, and selections are made by pointing directly at screen objects or locations. A mouse allows indirect interaction; its coordinate system is usually aligned with the desk top, and selections are made by moving it to indirectly position a screen cursor. This is important because an application must display a cursor to support indirect interactions, while a cursor is not necessary for direct interactions. A locator's device handler reports this attribute using service 8, "Locator Attributes."

The range of a locator's coordinate system and the number of buttons it supports may vary, depending upon each peripheral's physical attributes. For example, a particular touchpanel may only report X and Y coordinates within a range of 0 to 500, and a particular mouse may have only two buttons. These attributes are important because applications often need to align a locator's coordinate system with the coordinate system of another device (e.g., a graphic display) and because some applications require locators with a minimum number of buttons. A locator's device handler reports these physical constraints using service 8, "Locator Attributes."

Table 15 lists all services provided by a logical locator and Table 16 lists all alerts. Table 17 lists all of the status codes returned by locator services.

Table 15
A logical locator provides nine core services and one extended service.

Name	Service ID	Core/Extended	Page [a]
Services Query	2	Core	C-1
Set Alert Mask	3	Core	C-2
Disable All Alerts	4	Core	C-2
Reset	5	Core	C-3
Locator On	6	Core	C-4
Locator Off	7	Core	C-4
Locator Attributes	8	Core	C-5
Locator State	9	Core	C-6
Set Position	10	Core	C-7
Redefine Range	11	Extended	C-8

[a] Pages appear in Appendix C of this publication.

Table 16
A logical locator provides three alerts.

Name	Alert ID	Core/Extended	Page[a]
Movement	0	Core	C-9
Button Pressed	1	Core	C-10
Button Released	2	Core	C-11

[a] Pages appear in Appendix C of this publication.

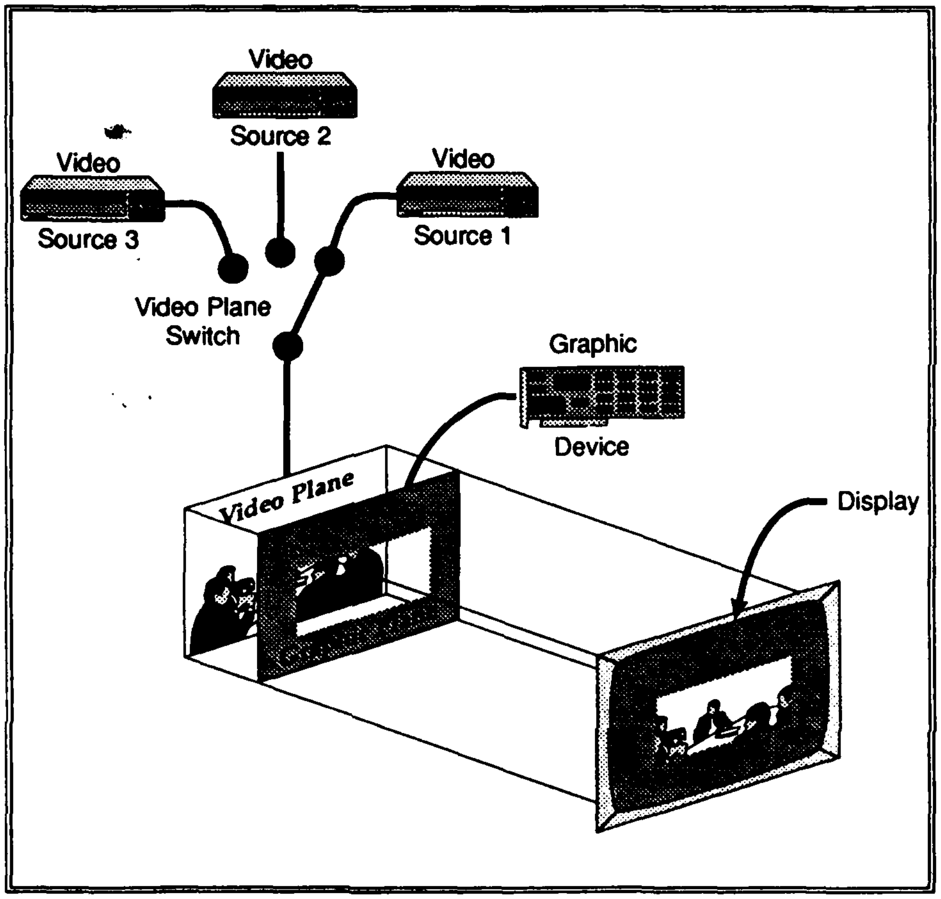
Table 17
A logical locator provides nine error codes.

Description	Error Code
Service successful	0
Unknown error	1
Device not available	2
Device handler busy	3
Locator not responding	4
Locator turned off	5
X-coordinate out of range	6
Y-coordinate out of range	7
Already initialized	8

6.3 Video/Graphics Overlay

A logical overlay device mixes two planes of visual information onto a single display device. Mixing is accomplished by controlling the transparency of the top plane, allowing portions of the bottom plane to show through. Figure 14 illustrates this concept. Imagery on each plane in Figure 14 is controlled by other, independent devices. The top plane, usually controlled by a graphic device, is called the graphic plane. The bottom plane presents imagery from one of several devices (videodisc players, VCRs, etc.) called external video sources. This plane is called the video plane. Service 8, "Select Video Input," is provided to select one source at a time for this plane and is depicted in Figure 14 by the video plane switch. Service 11, "Align Graphic Plane," is used to adjust the two planes' relative alignment so applications can allow operators to calibrate the two displays.

Figure 14
A logical overlay device mixes two planes of visual information onto a single display.



The overlay device's graphic plane is made up of thousands of tiny fixed rectangular regions, called pixels. A graphic device paints pictures on this plane by adjusting the color of each pixel. For example, to paint a red horizontal line on a white background, a graphic device might paint all pixels on the graphic plane white, then color all pixels in the fourth row red. Figure 15 illustrates this concept.

Graphic devices paint pixels by assigning numbers to them and then using a color palette to assign a hue to each number. Figure 16 demonstrates this technique by presenting a red (1) box with a yellow (2) interior on a blue (0) background. Numbers assigned to pixels in the graphic plane are called logical colors, and can range from 0 to 65535.

Just as a graphic device uses a color palette to assign hues to each logical color, the overlay device uses a transparency palette to assign a transparency to each logical color. Figure 17 illustrates this principle. In this figure, the graphic device has painted a red (1) box with a yellow (2) interior on a blue (0) background. The overlay device's transparency palette has prescribed logical colors 0 and 1 as opaque (255) and logical color 2 as translucent (100). The resulting mixed image presents an opaque blue background with an opaque red box filled with a yellow-tinged (translucent) video image.

Figure 15
A graphic device paints pictures by adjusting the color of individual pixels.

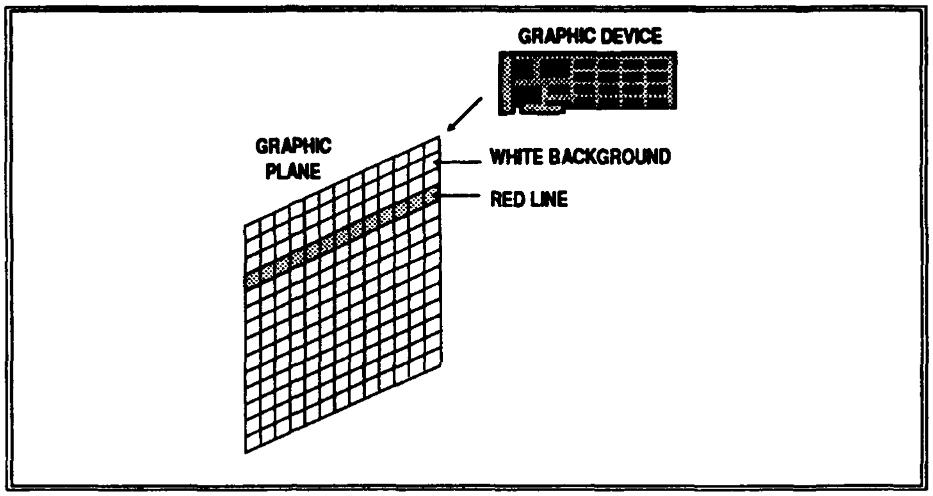


Figure 16
Graphic devices paint pixels by assigning numbers, called logical colors, to them.

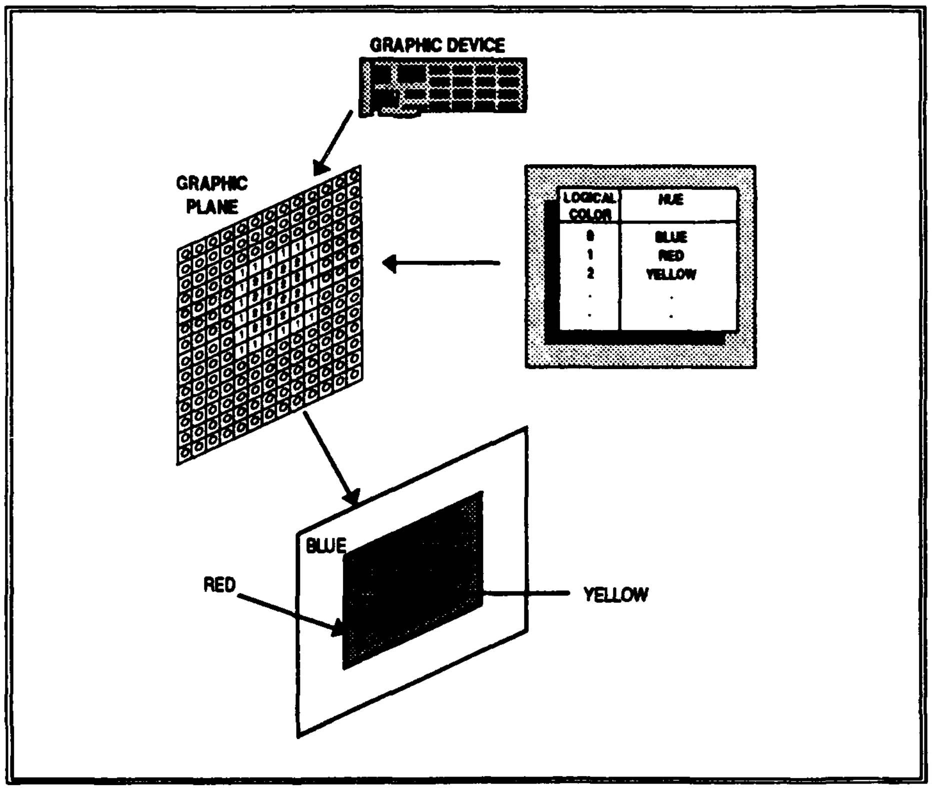
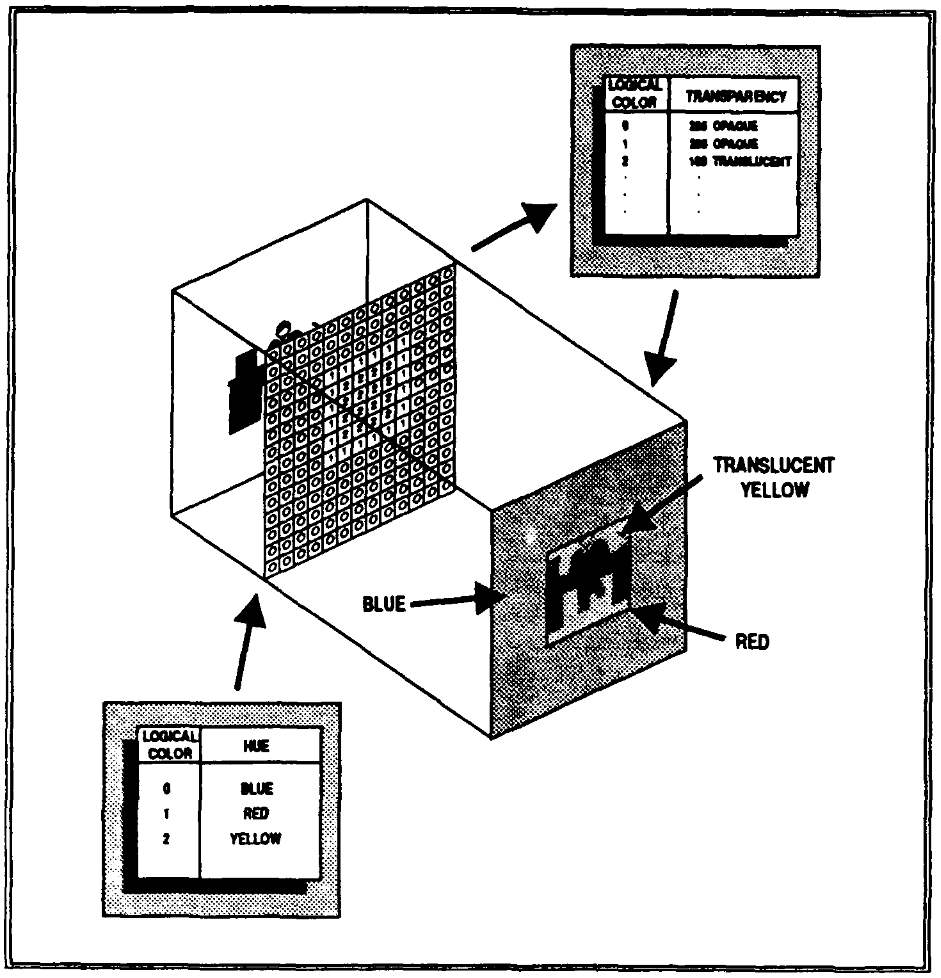


Figure 17
A transparency palette assigns a transparency to each logical color.

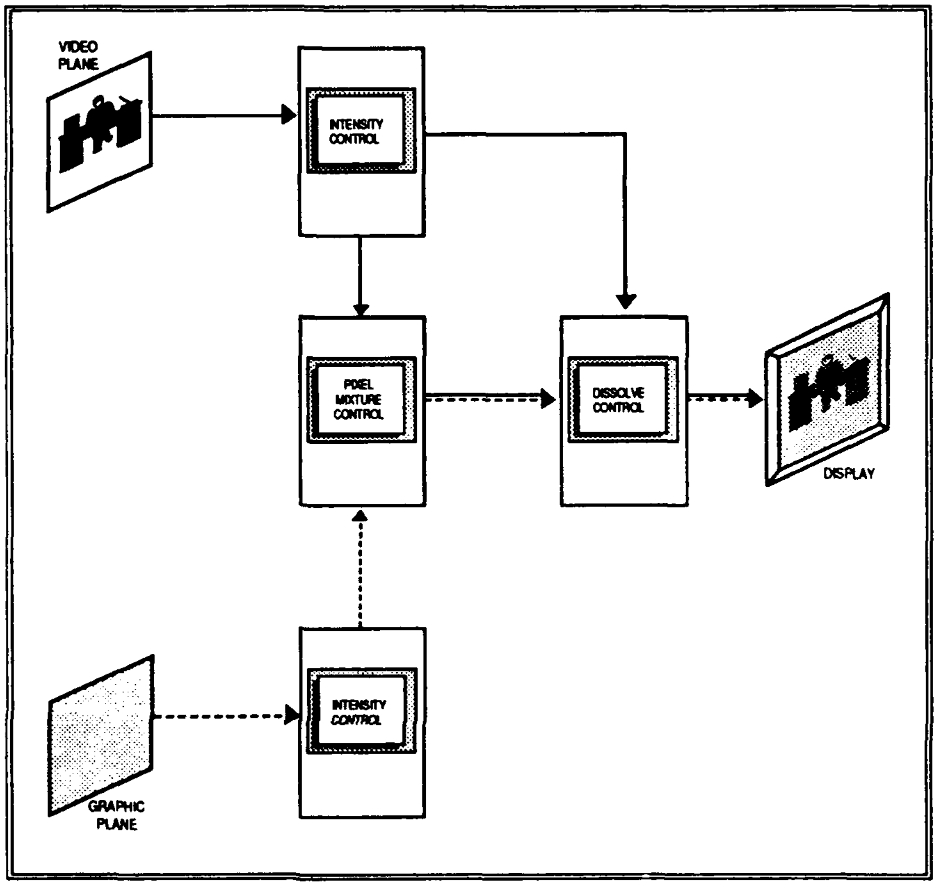


A transparency palette has 256 entries, and each entry defines the transparency of a single logical color. Each entry can range from 0 (transparent) to 255 (opaque). Service 6, "Set Colors Transparent/Opaque," is provided to set palette entries to either 0 or 255, and service 13, "Set Colors Translucent," is provided to set translucent tones.

To mix pictures from its two planes onto a single display, an overlay device uses the model illustrated in Figure 18. Lines with arrows in this figure represent pictures flowing from the graphic and video planes (on the left) through various controls (boxes in the middle) to the display (on the right). Dark lines with bold arrows represent video pictures, dotted lines with bold arrows reflect graphic pictures, and double lines (one solid, one dotted) with bold arrows depict an overlaid image (part video, part graphic).

The first boxes encountered by both graphic and video pictures in this model are labeled "Intensity Control." As this name suggests, an overlay device can adjust the intensity (or brightness) of pictures from both its video and its graphic planes before mixing them. Services 9, "Set Video Intensity On/Off," and 10, "Set Graphic Intensity On/Off," toggle the intensity of each picture between maximum (on) and minimum (off) brightness. Like adjusting a television's brightness knob, *extended services* 14, "Set Video Intensity," and 15, "Set Graphic Intensity," provide 256 gradations of intensity between 0 (off) and 255 (maximum brightness).

Figure 18
An overlay device uses this model to mix pictures from its two planes on a single display.



In the middle of Figure 18, both pictures flow through a "Pixel Mixture Control" box. This box scans each graphic pixel and mixes it with video according to its color's transparency. Pixels with opaque colors have no effluent video component, while transparent pixels are mixed with full video (they have no effluent graphic component). Translucent colors are mixed with a relative portion of video.

The pixel mixture control box uses the transparency palette to determine each pixel's video component. However, it can also be directed to ignore the transparency palette and to arbitrarily view all pixels as opaque, using service 7, "Transparancy Palette Enabled/Disabled." An application might use this service to momentarily hide a display's video image without disrupting its arrangement of transparent and translucent regions.

Before reaching the display, Figure 18's pictures pass through a final mixing box labeled "Dissolve Control." This box adds more video to every pixel, using a scaling factor called the dissolve level. Service 16, "Set Dissolve," is provided to regulate the dissolve level between 0 percent and 100 percent. Service 16 is commonly used to vary this scaling factor over a few seconds to produce the effect of dissolving graphics.

Quantitatively, the dissolve level is applied as a scaling factor to each pixel's transparency, as illustrated in equation 1, to determine the pixel's final display mixture.

Equation 1
Pixel display mixture.

Final Pixel Mixture = (Pixel Transparency) X (Dissolve Level)

In this equation, both the pixel's transparency (as determined by its color's transparency palette entry) and its final mixture range from 255 (opaque, no video) to 0 (transparent, all video). When the dissolve level is 100 percent, it has no effect upon the pixel's appearance. (This is its default level.) When the dissolve level is 0 percent, all pixels become transparent (their final mixture is 0). A display's graphics will disappear as the dissolve level varies from 100 percent to 0 percent, and will reappear as it returns to 100 percent.

Table 18 lists all services provided by a logical overlay device and Table 19 lists all alerts. Table 20 lists all status codes returned by a logical overlay device.

Table 18
A logical overlay device provides 11 core services and four extended services.

Name	Service ID	Core/Extended	Page[a]
Services Query	2	Core	D-1
Set Alert Mask	3	Core	D-2
Disable All Alerts	4	Core	D-2
Reset	5	Core	D-3
Set Colors Transparent/Opaque	6	Core	D-4
Transparency Palette Enabled/Disabled	7	Core	D-5
Select Video Input	8	Core	D-5
Set Video Intensity On/Off	9	Core	D-6
Set Graphic Intensity On/Off	10	Core	D-6
Align Graphic Plane	11	Core	D-7
Status Query	12	Core	D-8
Set Colors Translucent	13	Extended	D-10
Set Video Intensity	14	Extended	D-11
Set Graphic Intensity	15	Extended	D-12
Set Dissolve	16	Extended	D-13

[a] Pages appear in Appendix D of this publication.

Table 19
A logical overlay device provides two core alerts.

Name	Alert ID	Core/Extended	Page[a]
Timed Service Completed	0	Core	D-14
Graphic Plane Mode Changed	1	Core	D-14

[a] Pages appear in Appendix D of this publication.

Table 20
A logical overlay device provides 11 error codes.

Description	Error Code
Service successful	0
Unknown error	1
Device not available	2
Device handler busy	3
Hardware not responding	4
Palette bound out of range	5
Invalid transparency palette entry	6
Video source out of range	7
Horizontal shift out of range	8
Vertical shift out of range	9
Already initialized	10

6.4 Audio Management

A logical audio management device mixes analog audio signals from several source channels and makes these mixtures available on several output channels. Typical audio sources include videodisc audio, digital audio, and the computer's speaker. Usually two output channels (left and right) are provided for stereo sound. These are typically connected to speakers, headphones, or a stereo amplifier.

To mix sound from several sources, an audio management device uses the model illustrated in Figure 19.

The mixture controls shown in Figure 19 determine the level (loudness) of each source channel before it is mixed. Figure 20 illustrates mixture control for a single output channel. Adjusting the level of each source channel in this figure determines how much sound the channel contributes to the final mixture. Service 8, "Set Source Level," sets the level of a particular source channel to one of 256 gradations of loudness between 0 (silent) and 255 (maximum loudness).

The audio source switches in Figure 19 suggest that an audio management device can turn a source channel on or off without changing its level setting. Service 6, "Audio Source On/Off," turns the selected source channel on or off. When a source channel is turned off, its sound does not contribute to the output mixture.

The output level control boxes shown in Figure 19 suggest that a logical audio management device can control the level of each output channel. Service 9, "Set Output Level," sets the level of a particular output channel to one of 256 gradations of loudness between 0 (silent) and 255 (maximum loudness). Just as with source channels, an audio management device can turn an output channel on or off without changing its level setting. Service 7, "Audio Output On/Off," turns the selected source channel on or off. When a source channel is turned off it is silent.

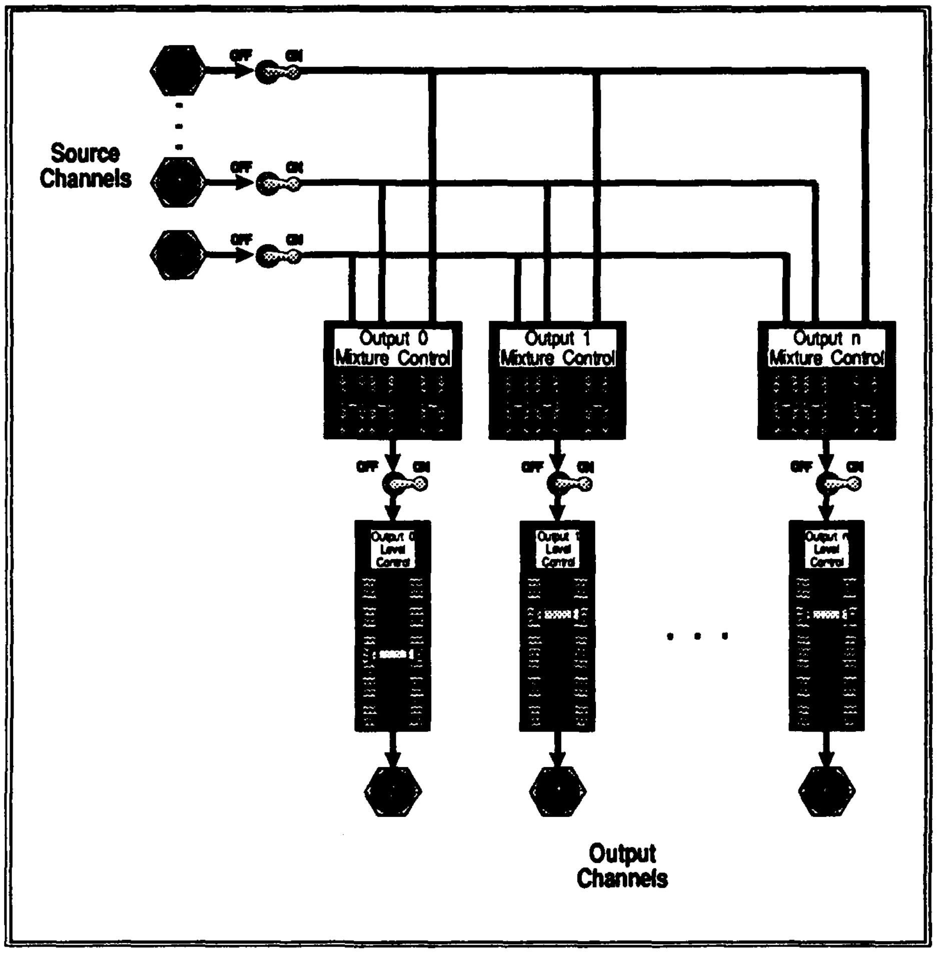


Figure 19
A logical audio management device mixes analog audio signals from several source channels and makes these mixtures available on several output channels.

Table 21 lists all services provided by a logical audio management device, and Table 22 lists all status codes.

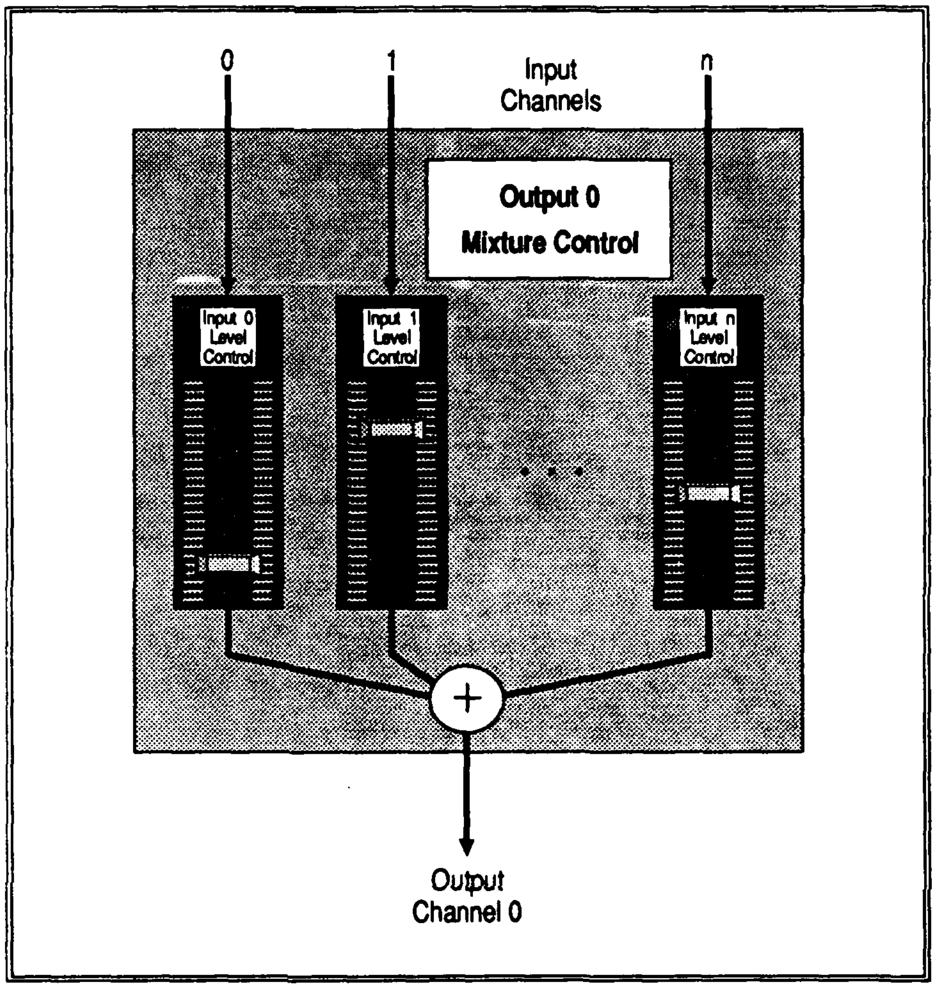


Figure 20
The mixture of source channels can be controlled for each output channel.

Table 21
A logical audio management device provides 12 core services.

Name	Service ID	Core/Extended	Page[a]
Services Query	2	Core	E-1
Set Alert Mask	3	Core	E-2
Disable All Alerts	4	Core	E-2
Audio Management Attributes	5	Core	E-3
Audio Source On/Off	6	Core	E-4
Audio Output On/Off	7	Core	E-4
Set Source Level	8	Core	E-5
Set Output Level	9	Core	E-6
Query Source State	10	Core	E-6
Query Output State	11	Core	E-7

[a] Pages appear in Appendix E of this publication.

Table 22
A logical audio management device provides eight error codes.

Description	Error Code
Service successful	0
Unknown error	1
Device not available	2
Device handler busy	3
Hardware not responding	4
Source out of range	5
Output out of range	6
Already initialized	7

7. Glossary

The following list defines terms used in this document. These terms are defined in the context of their use in this document and in the other documents listed in Table (?). The definitions may therefore be more restrictive than, or otherwise differ from, the commonly accepted definitions. Words that are italicized in definitions are themselves defined elsewhere in this list.

Alert	A service that asynchronously informs an *application* of device activity.
Alert packet	A packet used to communicate an *alert* between *layers* of the *PORTCO architecture.*
Application	*Application software.*
Application layer	The highest partition in the *PORTCO architecture.* Contains the *DSI toolbox.*
Application software	Any software that is part of the *application layer.*
Architecture	The organization or structure of a system or of a system component.
Core service	A service within a *device class* that must be provided by every compliant *device handler* in the class.
Courseware	Software and/or data used to present computer-based instruction.
Device class	A collection of services provided by a single *logical device.*
Device handler	A *software module* that implements the *DHI* for a single *device class.* Translates requests for service from a *logical device* into instructions that a physical *peripheral* can understand.
Device handler layer	The lowest *layer* of the *PORTCO architecture.* Contains *device handlers.*
Device Handler Interface (DHI)	A standard collection of services and *protocols* that defines the boundary between the *R&C layer* and the *device handler layer.*

Device Services Interface (DSI)	A standard collection of services and *prctocols* that defines the boundary between the *application layer* and the *R&C layer.*
DSI toolbox	A *software module* (or modules) providing an *interface* between the *application software* and the *R&C layer.*
Extended service	A service within a *device class* that may be provided by compliant *device handlers* in the class.
Interface	A *software interface.*
Interrupt service routine (ISR)	A *software module* invoked by a processor interrupt.
Layer	A group of related functions that makes up one level of a *layered architecture.*
Layered architecture	A *software architecture* in which components are grouped in a hierarchical arrangement in such a way that each *layer* provides functions and services to adjacent *layers.*
Logical device	A conceptual device synthesized by using characteristics of several similar *peripherals.* Specified by a *device class.*
Packet	A contiguous block of data used to communicate information between *layers* of the *PORTCO architecture.*
Peripheral device	Any computer system hardware component that is distinct from a computer's main processor.
PORTCO architecture	A *layered architecture* presenting a standard *interface* between *peripheral devices* and *applications.*
Protocol	A set of rules governing the communication between two *software modules.*
Registers	The internal registers of the 80x86 processor. These include the data registers (AX, BX, CX, DX), *stack* pointer (*SP*), base pointer (BP), source index (SI), destination index (DI), code *segment* (CS), data *segment* (DS), *stack segment* (*SS*), extra *segment* (ES), and flags.

Request packet	A packet used to communicate a service request between *layers* of the *PORTCO architecture.*
Routing and configuration layer	The middle partition of the *PORTCO architecture.*
R&C layer	*Routing and configuration layer.*
Segment	A 64-k byte block of memory starting at an address that is evenly divisible by 16.
Software interface	The boundary between two or more *software modules,* or a *protocol* that defines how two *software modules* communicate.
Software module	A named collection of software instructions and data.
SP	The *stack* pointer *register* of the 80x86 processor.
SS	The *stack segment register* of the 80x86 processor.
Stack	A dynamically shrinking and expanding area of memory in which data items are stored in consecutive order and removed on a last-in, first-out basis. The *stack* is the section of memory used by the CPU to store return addresses from subroutine calls and interrupts.
TSR program	An MS-DOS terminate-and-stay-resident program.

8. References

Van de Wetering, B. L., & Thomason, B. L. (April 1990) *The MS-DOS Device Handler Interface (TN-90-16).* San Diego: Navy Personnel Research and Development Center.

Thomason, B. L., Van de Wetering, B. L., & Booth, R. G. (March 1990) *A Portable Courseware Architecture (TN-90-11).* San Diego: Navy Personnel Research and Development Center.

Van de Wetering, B. L., & Thomason, B. L. (in preparation) *Guidelines for Implementing MS-DOS PORTCO Device Handlers.* San Diego: Navy Personnel Research and Development Center.

APPENDIX A

R&C SERVICES

Name **Configuration Status Query**

Service ID 0

Description Provides information about the system's device configuration to the application. Tells the application which logical devices are active, and returns the values of the service and alert interrupts. The device class number in this service's packet must be set to 255 to indicate that this request will be serviced by the R&C layer rather than being passed to a device handler.

Block Format

Field Name	Set By[a]	Byte #	Format[b]	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	0	
Block Length	A	2-3	16-bit uns. int.	12	
Status	RC	4	8-bit uns. int.	0 = Service successful 1 = Service unsuccessful	
Request Interrrupt	RC	5	8-bit uns. int.		
Alert Interrupt	RC	6	8-bit uns. int.		
Number of Active Logical Devices	RC	7	8-bit uns. int.		
Logical Device Array Address	RC	8-11	32-bit address		(1)

[a] Throughout Appendix A, this column indicates which program(s) set the specified field: A = application; RC = R&C program; DH = device handler.
[b] Throughout Appendix A, the abbreviation "uns. int." = unsigned integer.

Note

1. Address of an array containing the device class and number for each active logical device. Each array entry contains two bytes. The first byte contains the device class number; the second byte contains the device number.

Name	**Terminate DSI**
Service ID	1
Description	Resets the beginning of MS-DOS's transient program area to the R&C program's load address and returns control to MS-DOS. Does not return to application. Invokes DHI service 1, "Terminate Device Handler," for each active device handler, restores request and alert interrupt vectors. Resets interrupt 12h vector.

To indicate that this request will be serviced by the R&C layer rather than being passed to a device handler, the device class number in this service's packet must be set to 255.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	1	
Block Length	A	2-3	16-bit uns. int.	5	
Status	RC	4	8-bit uns. int.		(1)

Note

1. This service never returns to the application.

APPENDIX B

VIDEODISC PLAYER SERVICES

Name **Services Query**

Service ID 2

Description Lists all services and alerts provided by the target device. Returns two bit-vectors, one describing services and one describing alerts. The N'th bit in each vector reflects support for the N'th service or alert. Allows an application to determine which extended services are supported by a particular device.

Block Format

Field Name	Set By[a]	Byte #	Format[b]	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	2	
Block Length	A	2-3	16-bit uns. int.	15	
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy	
Request Vector Byte Length	DH	5	8-bit uns. int.		
Request Vector Address	DH	6-9	32-bit address to bit-vector		(1)
Alert Vector Byte Length	DH	10	8-bit uns. int.		
Alert Vector Address	DH	11-14	32-bit address to bit-vector		(1)

[a] Throughout Appendix B, this column indicates which program(s) set the specified field: A = application; RC = R&C program; DH = device handler.
[b] Throughout Appendix B, the abbreviations used in this column are: "uns. int." = unsigned integer; "2's comp. int." = two's complement integer.

Note 1. Bits set to 1 indicate a supported service. Bits set to 0 reflect an unsupported service.

Name **Set Alert Mask**

Service ID 3

Description Enables and disables alerts based on the contents of a bit-vector, called the alert mask. This mask has the same format as service 2's alert vector: the N'th bit in the mask corresponds with the N'th alert. If the bit is 1, the device handler will issue the alert. If the bit is 0, the device handler will not issue the alert. All alerts are disabled by default.

Block Format

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	3
Block Length	A	2-3	16-bit uns. int.	10
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy
Alert Mask Byte Length	A	5	8-bit uns. int.	
Alert Mask Address	A	6-9	32-bit address to bit-vector	

Name **Disable All Alerts**

Service ID 4

Description Disables all alerts.

Block Format

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	4
Block Length	A	2-3	16-bit uns. int.	5
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy

Name	**Player Status**
Service ID	5
Description	Returns current videodisc player status.
Block Format	

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	5
Block Length	A	2-3	16-bit uns. int.	12
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Player not responding
Videodisc Status	DH	5	8-bit uns. int.	0 = Ready 1 = Player door open 2 = No videodisc in player 3 = Videodisc parked
Audio Channel 1	DH	6	8-bit uns. int.	0 = Channel 1 off 1 = Channel 1 on
Audio Channel 2	DH	7	8-bit uns. int.	0 = Channel 2 off 1 = Channel 2 on
Frame Display	DH	8	8-bit uns. int.	0 = Frame numbers off 1 = Frame numbers on
Chapter Display	DH	9	8-bit uns. int.	0 = Chapter numbers off 1 = Chapter numbers on
Video On/Off	DH	10	8-bit uns. int.	0 = Video off 1 = Video on
Current Motion	DH	11	8-bit 2's comp. int.	-4 = Scan reverse -3 = Fast reverse -2 = Slow reverse -1 = Normal reverse 0 = Still 1 = Normal forward 2 = Slow forward 3 = Fast forward 4 = Scan forward

Name	**Videodisc Status**
Service ID	6
Description	Returns information about the current videodisc.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	6	
Block Length	A	2-3	16-bit uns. int.	15	
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Player not responding	
Videodisc Status	DH	5	8-bit uns. int.	0 = Ready 1 = Player door open 2 = No videodisc in player 3 = Videodisc parked	
Type	DH	6	8-bit uns. int.	0 = CAV 1 = CLV 2 = Other	
Format	DH	7	8-bit uns. int.	0 = NTSC 1 = PAL 2 = Other	
Size	DH	8	8-bit uns. int.	0 = Unknown >0 = Diameter in centimeters	
Chapter Coding	DH	9	8-bit uns. int.	0 = Unavailable 1 = Available	
Side Number	DH	10	8-bit uns. int.	1 = Side one active 2 = Side two active 3 = Unknown	
First Frame Number	DH	11-12	16-bit uns. int.		(1)
Last Frame Number	DH	13-14	16-bit uns. int.		(1)

Notes

1. Integer between 1 and 54,000.

Name	**Position Request**
Service ID	7
Description	Returns the current videodisc frame number.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	7	
Block Length	A	2-3	16-bit uns. int.	7	
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Player not responding 5 = Player busy 6 = Videodisc parked 7 = Ejected 8 = No videodisc in player 21 = Player spun down	
Frame Number	DH	5-6	16 bit uns. int.		(1)

Note

1. *If the videodisc is currently playing motion video, the position may* not be accurate because of the time required for communication with the player.

Name **Spin Up/Down**

Service ID 8

Description Spins the videodisc up or down. After the videodisc is spun down, the player will be unable to display an image or play an audio track until it is spun up again. After the videodisc is spun up, the player is placed in still mode on the videodisc's first readable frame. Only services 0 through 6 can be successfully invoked when the player is not spun up. If this service attempts to place the videodisc player in the state it is already in, the service has no effect.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	8	
Block Length	A	2-3	16-bit uns. int.	7	
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Player not responding 5 = Player busy 7 = Ejected 8 = No videodisc in player 21 = Player spun down	
Sync/ Async	A	5	8-bit uns. int.	0 = Asynchronous 1 = Synchronous	(1)
Spin Up/Down	A	6	8-bit uns. int.	0 = Spin videodisc down 1 = Spin videodisc up	

Note

1. Specifies whether this service will be executed synchronously or asynchronously. When executed asynchronously, alert 0, "Service Complete," is issued when the service is complete or has failed. If any other service is invoked during an asynchronous invocation of service 8, "Spin Up/Down," a "player busy" status will be returned.

Name **Eject**

Service ID 9

Description Spins down the videodisc and opens the videodisc player door so the videodisc may be removed. When executed asynchronously, only services 0 through 6 can be successfully invoked before this service completes. If any other service is invoked before an asynchronous invocation of service 9, "Eject," completes, a "player busy" status will be returned.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	9	
Block Length	A	2-3	16-bit uns. int.	6	
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Player not responding 5 = Player busy 7 = Ejected 20 = Must open with front panel	
Sync/ Async	A	5	8-bit uns. int.	0 = Asynchronous 1 = Synchronous	(1)

Note 1. Specifies whether this service will be executed synchronously or asynchronously. When executed asynchronously, alert 0, "Service Complete," is issued when the service is complete or has failed.

Name **Frame Search**

Service ID 10

Description Searches to the specified frame. Upon reaching the specified frame, the videodisc player enters still mode. When executed asynchronously, only services 1 through 6 can be successfully invoked before this service completes. If any other service is invoked before an asynchronous invocation of service 10, "Frame Search," completes, a "player busy" status will be returned. This service does not affect service 14, "Video On/Off." However, video output may be blanked while the player is searching, depending on the player and the search distance.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	10	
Block Length	A	2-3	16-bit uns. int.	8	
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Player not responding 5 = Player busy 6 = Videodisc parked 7 = Ejected 8 = No videodisc in player 9 = Invalid frame number 21 = Player spun down	
Sync/ Async	A	5	8-bit uns. int.	0 = Asynchronous 1 = Synchronous	(1)
Target Frame	A	6-7	16-bit uns. int.	Positive integer between 1 and 54,000	

Note

1. Specifies whether this service will be executed synchronously or asynchronously. When executed asynchronously, alert 0, "Service Complete," is issued when the service is complete or has failed.

Name **Jump**

Service ID 11

Description Causes a jump, without video blanking, to a new frame that is within 99 frames in either direction of the current frame. When executed asynchronously, only services 1 through 6 can be successfully invoked before this service completes. If any other service is invoked before an asynchronous invocation of service 11, "Jump," completes, a "player busy" status will be returned.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	11	
Block Length	A	2-3	16-bit uns. int.	7	
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Player not responding 5 = Player busy 6 = Videodisc parked 7 = Ejected 8 = No videodisc in player 11 = Invalid jump offset 13 = Destination unreachable 21 = Player spun down	
Sync/ Async	A	5	8-bit uns. int.	0 = Asynchronous 1 = Synchronous	(1)
Jump Offset Frames/ Direction	A	6	8-bit 2's comp. int.	-1 to -99 = Jump N frames backward 0 = No jump 1 to 99 = Jump N frames forward	

Note 1. Specifies whether this service will be executed synchronously or asynchronously. When executed asynchronously, alert 0, "Service Complete," is issued when the service is complete or has failed.

Name	**Still**
Service ID	12
Description	Immediately overrides asynchronous execution of service 22, "Chapter Play" or service 23, "Motion," and causes the videodisc player to enter still mode at the current frame. Attempts to execute this command during any other asynchronous command will result in "player busy" status.

Block Format

Field Name	**Set By**	**Byte #**	**Format**	**Possible Values**
Service ID	A	0-1	16-bit uns. int.	12
Block Length	A	2-3	16-bit uns. int.	5
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Player not responding 5 = Player busy 6 = Videodisc parked 7 = Ejected 8 = No videodisc in player 21 = Player spun down

Name **Chapter Search**

Service ID 13

Description Searches to the specified chapter. On reaching the specified chapter, the videodisc player enters still mode. When executed asynchronously, only services 1 through 6 can be successfully invoked before this service completes. If any other service is invoked before an asynchronous invocation of service 13, "Chapter Search," completes, a "player busy" status will be returned. Execution of this service does not affect service 14, "Video On/Off." However, video output may be blanked on searching to the specified chapter, depending on the player and the search distance.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	13	
Block Length	A	2-3	16-bit uns. int.	8	
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Player not responding 5 = Player busy 6 = Videodisc parked 7 = Ejected 8 = No videodisc in player 10 = Invalid chapter number 12 = Chapters not available 21 = Player spun down	
Sync/ Async	A	5	8-bit uns. int.	0 = Asynchronous 1 = Synchronous	(1)
Target Chapter	A	6-7	16-bit uns. int.		

Note 1. Specifies whether this service will be executed synchronously or asynchronously. When executed asynchronously, alert 0, "Service Complete," is issued when the service is complete or has failed.

Name	**Video On/Off**
Service ID	14
Description	Enables and disables video output from the videodisc player. Other videodisc player services do not change this state. When this service disables the video signal, only another invocation of this service will enable it.

Block Format

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	14
Block Length	A	2-3	16-bit uns. int.	6
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Player not responding 5 = Player busy 7 = Ejected 21 = Player spun down
Video On/Off	A	5	8-bit uns. int.	0 = Turn video signal off 1 = Turn video signal on

Name **Audio1 On/Off**

Service ID 15

Description Enables and disables output from audio channel 1 at the videodisc player. The state of audio channel 1 does not affect the state of audio channel 2.

Block Format

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	15
Block Length	A	2-3	16-bit uns. int.	6
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Player not responding 5 = Player busy 7 = Ejected 21 = Player spun down
Audio1 On/Off	A	5	8-bit uns. int.	0 = Turn audio channel 1 off 1 = Turn audio channel 1 on

Name **Audio2 On/Off**

Service ID 16

Description Enables and disables output from audio channel 2 at the videodisc player. The state of audio channel 2 does not affect the state of audio channel 1.

Block Format

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	16
Block Length	A	2-3	16-bit uns. int.	6
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Player not responding 5 = Player busy 7 = Ejected 21 = Player spun down
Audio2 On/Off	A	5	8-bit uns. int.	0 = Turn audio channel 2 off 1 = Turn audio channel 2 on

Name **Set Stop**

Service ID 17

Description Specifies a frame at which the videodisc player will enter still mode in any current or future motion commands. This command used in conjunction with the motion command constitutes a bounded play. Alert 1, "Frame Arrival," is issued when the specified frame is reached. Once reached, exceeded, or replaced by a subsequent invocation of the service, the specified frame number has no significance. If possible, the player stops at the exact frame specified. Under conditions that make this impossible (i.e., fast motion), error is kept to a minimum.

Block Format

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	17
Block Length	A	2-3	16-bit uns. int.	7
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Player not responding 5 = Player busy 6 = Videodisc parked 7 = Ejected 8 = No videodisc in player 9 = Invalid frame number 21 = Player spun down
Target Frame	A	5-6	16-bit uns. int.	

Name	**Set Inform Flag**
Service ID	18
Description	Specifies a frame that, when reached, will cause the device handler to issue alert 1, "Frame Arrival."

Block Format

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	18
Block Length	A	2-3	16-bit uns. int.	7
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Player not responding 5 = Player busy 6 = Videodisc parked 7 = Ejected 8 = No videodisc in player 9 = Invalid frame number 21 = Player spun down
Target Frame	A	5-6	16-bit uns. int.	

Name **Remote Control On/Off**

Service ID 19

Description Enables and disables the videodisc player's remote and front-panel controls. When the remote control is disabled, the videodisc player is under computer control. When enabled, the player can be controlled by either the remote unit or the computer.

Block Format

Field Name	**Set By**	**Byte #**	**Format**	**Possible Values**
Service ID	A	0-1	16-bit uns. int.	19
Block Length	A	2-3	16-bit uns. int.	6
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Player not responding 5 = Player busy 6 = Videodisc parked 7 = Ejected 8 = No videodisc in player 21 = Player spun down
On/Off	A	5	8-bit uns. int.	0 = Disable remote control 1 = Enable remote control

Name **Frame Display On/Off**

Service ID 20

Description Enables and disables display of the current frame number as part of the video picture.

Block Format

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	20
Block Length	A	2-3	16-bit uns. int.	6
Status	RC/DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Player not responding 5 = Player busy 7 = Ejected 21 = Player spun down

On/Off	A	5	8-bit uns. int.	0 = Turn frame # display off
				1 = Turn frame # display on

Name **Chapter Display On/Off**

Service ID 21

Description Enables and disables display of the current chapter number as part of the video picture.

Block Format

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	21
Block Length	A	2-3	16-bit uns. int.	6
Status	RC/DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Player not responding 5 = Player busy 7 = Ejected 12 = Chapters not available 21 = Player spun down

On/Off	A	5	8-bit uns. int.	0 = Turn chapter # display off
				1 = Turn chapter # display on

Name **Chapter Play**

Service ID 22

Description Searches to the specified chapter and begins to play forward at normal speed until the end of the chapter is reached. At the end of the chapter, the videodisc player enters still mode and video output is turned off. During asynchronous operation, all other services operate as specified. Execution of this service does not affect service 14, "Video On/Off"; however, video output may be blanked while searching to the beginning of the specified chapter, depending on the player and the search distance.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	22	
Block Length	A	2-3	16-bit uns. int.	8	
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Player not responding 5 = Player busy 6 = Videodisc parked 7 = Ejected 8 = No videodisc in player 10 = Invalid chapter number 12 = Chapters not available 18 = Interrupted before completion 21 = Player spun down	
Sync/ Async	A	5	8-bit uns. int.	0 = Asynchronous 1 = Synchronous	(1)
Target Chapter	A	6-7	16-bit uns. int.		

Note

1. Specifies whether this service will be executed synchronously or asynchronously. When executed asynchronously, alert 0, "Service Complete," will be issued when the service has been completed or has failed. If another service request interrupts asynchronous performance, alert 0 will return a status of 18, "Interrupted Before Completion."

Name **Motion**

Service ID 23

Description Causes the videodisc player to begin to play in the specified direction at the specified speed from the current frame. Returns immediately after initiating motion, and is thus inherently asynchronous. All other services operate as specified during motion. Alert 1, "Frame Arrival," will be issued when motion reaches the beginning or end of the videodisc.

Block Format

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	23
Block Length	A	2-3	16-bit uns. int.	6
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Player not responding 5 = Player busy 6 = Videodisc parked 7 = Ejected 8 = No videodisc in player 14 = Invalid speed selection 15 = Player already at first frame 16 = Player already at last frame 21 = Player spun down
Speed/ Direction	A	5	8-bit 2's comp. int.	-4 = Scan reverse -3 = Fast reverse -2 = Slow reverse -1 = Normal reverse 0 = Still 1 = Normal forward 2 = Slow forward 3 = Fast forward 4 = Scan forward

Name	**Service Status Query**
Service ID	24
Description	Requests the completion status of the most recently solicited service.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	24	
Block Length	A	2-3	16-bit uns. int.	8	
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Player not responding 5 = Player busy	
ID of Reported Service	DH	5-6	16-bit uns. int.		
Status of Reported Service	DH	7	8-bit uns. int.		(1)

Note 1. Status values are listed in the specification for each request.

Name	**Service Complete**
Alert ID	0
Description	Issued when an asynchronously executed service has been successfully completed or has failed.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Alert ID	DH	0-1	16-bit uns. int.	0	
Block Length	DH	2-3	16-bit uns. int.	7	
ID of Reported Service	DH	4-5	16-bit uns. int.	6 = Spin up/down 7 = Eject 8 = Frame search 9 = Jump 11 = Chapter search 20 = Chapter play	
Status of Reported Service	DH	6	8-bit uns. int.		(1)

Note 1. Status values are listed in the specification for each request.

Name	**Frame Arrival**
Alert ID	1
Description	Issued when the frame set by the "Set Stop" or "Set Inform Flag" service has been reached or when service 23, "Motion," reaches the beginning or end of the videodisc.

Block Format

Field Name	Set By	Byte #	Format	Possible Values
Alert ID	DH	0-1	16-bit uns. int.	1
Block Length	DH	2-3	16-bit uns. int.	6
Service ID	DH	4-5	16-bit uns. int.	17 = Set stop 18 = Set inform flag 23 = Motion

APPENDIX C

LOCATOR SERVICES

Name **Services Query**

Service ID 2

Description Lists all services and alerts provided by the target device. Returns two bit-vectors, one describing services and one describing alerts. The N'th bit in each vector reflects support for the N'th service or alert. Allows an application to determine which extended services are supported by a particular device.

Block Format

Field Name	Set By[a]	Byte #	Format[b]	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	2	
Block Length	A	2-3	16-bit uns. int.	15	
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy	
Request Vector Byte Length	DH	5	8-bit uns. int.		
Request Vector Address	DH	6-9	32-bit address to bit-vector		(1)
Alert Vector Byte Length	DH	10	8-bit uns. int.		
Alert Vector Address	DH	11-14	32-bit address to bit-vector		(1)

[a] Throughout Appendix C, this column indicates which program(s) set the specified field: A = application; RC = R&C program; DH = device handler.
[b] Throughout Appendix C, the abbreviations used in this column are: "uns. int." = unsigned integer; "2's comp. int." = two's complement integer.

Note 1. Bits set to 1 indicate a supported service. Bits set to 0 reflect an unsupported service.

Name **Set Alert Mask**

Service ID 3

Description Enables and disables alerts based on the contents of a bit-vector, called the alert mask. This mask has the same format as service 2's alert vector: The N'th bit in the mask corresponds with the N'th alert. If the bit is 1, the device handler will issue the alert. If the bit is 0, the device handler will not issue the alert. All alerts are disabled by default.

Block Format

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	3
Block Length	A	2-3	16-bit uns. int.	10
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy
Alert Mask Byte Length	A	5	8-bit uns. int.	Length of mask in bytes
Alert Mask Address	A	6-9	32-bit address to bit-vector	

Name **Disable All Alerts**

Service ID 4

Description Disables all alerts.

Block Format

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	4
Block Length	A	2-3	16-bit uns. int.	5
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy

Name	**Reset**
Service ID	5
Description	Causes the locator's device handler to establish communications with its peripheral, perform any hardware-specific initialization, set the current location of the locator to (0, 0), and turn the locator on so that it is ready to respond to subsequent service requests. For example, a serial touchpanel handler might reset its communications channel, revector the serial port interrupt if necessary, and reset the touchpanel.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	5	
Block Length	A	2-3	16-bit uns. int.	5	
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Locator not responding	(1)

Note

1. Individual manufacturers may define additional error codes to indicate malfunctions specific to their hardware.

Name **Locator On**

Service ID 6

Description Causes the locator's device handler to process all subsequent services, to respond to activity from the peripheral by asynchronously recording position changes, and to issue all alerts that have not been masked.

Block Format

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	6
Block Length	A	2-3	16-bit uns. int.	5
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Locator not responding

Name **Locator Off**

Service ID 7

Description Causes the locator's device handler to ignore subsequent activity from the peripheral, to respond to all service requests except service 6, "Locator On," and service 8, "Locator Attributes," with an error code, and to stop issuing alerts regardless of the alert mask. This service should be invoked when an application wants to ignore locator input for an extended time. Turning the locator off may improve system performance by minimizing device handler background processing.

Block Format

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	7
Block Length	A	2-3	16-bit uns. int.	5
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Locator not responding

Name **Locator Attributes**

Service ID 8

Description Provides information about the locator's coordinate system and number of buttons.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	8	
Block Length	A	2-3	16-bit uns. int.	19	
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Locator not responding	
Button Config- uration	DH	5	8-bit uns. int.	Number of locator buttons	
Maximum X-Value	DH	6-7	16-bit 2's comp. int.		
Maximum Y-Value	DH	8-9	16-bit 2's comp. int.		
Minimum X-Value	DH	10-11	16-bit 2's comp. int.		
Minimum Y-Value	DH	12-13	16-bit 2's comp. int.		
X-Aspect	DH	14-15	16-bit 2's comp. int.		(1)
Y-Aspect	DH	16-17	16-bit 2's comp. int.		(1)
Direct/ Indirect Interaction	DH	18	8-bit uns. int.	0 = Direct interaction 1 = Indirect interaction 2 = Interaction type unknown	

Note

1. Used to calculate the locator's aspect ratio. This ratio is: X-aspect/Y-aspect. The aspect ratio indicates the physical size of one unit on the X-axis relative to the physical size of one unit on the Y-axis. For example, an aspect ratio of 1 indicates that the units on the X-axis represent the same physical distance as the units on the Y-axis. An aspect ratio of 2 indicates that the units on the X-axis represent twice the physical distance of the units on the Y-axis.

Name	**Locator State**
Service ID	9
Description	Provides information about the current locator state. Returns the most recent locator position and the state of all buttons.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	9	
Block Length	A	2-3	16-bit uns. int.	41	
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Locator not responding 5 = Locator turned off	
X-Coordinate	DH	5-6	16-bit 2's comp. int.		
Y-Coordinate	DH	7-8	16-bit 2's comp. int.		
Button Vector	DH	9-40			(1)

Note

1. This field is a bit-vector in which the N'th bit specifies the state of the N'th logical button (see Figure 13 in the main body of this document). If a bit's value is 1, its logical button is pressed; otherwise it is released.

Name	**Set Position**
Service ID	10
Description	Set the current locator position to coordinates passed in the request block. Allows applications to set a new reference point for peripherals that return only movement information (e.g., mouse, keypad, etc.).

Block Format

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	10
Block Length	A	2-3	16-bit uns. int.	9
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Locator not responding 5 = Locator turned off 6 = X-coordinate out of range 7 = Y-coordinate out of range
New X-Coordinate	A	5-6	16-bit 2's comp. int.	
New Y-Coordinate	A	7-8	16-bit 2's comp. int.	

Name	**Redefine Range**
Service ID	11
Description	Changes the boundaries of the locator's coordinate system.
Block Format	

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	11
Block Length	A	2-3	16-bit uns. int.	13
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Locator not responding 5 = Locator turned off
Maximum X-Value	A	5-6	16-bit 2's comp. int.	
Maximum Y-Value	A	7-8	16-bit 2's comp. int.	
Minimum X-Value	A	9-10	16-bit 2's comp. int.	
Minimum Y-Value	A	11-12	16-bit 2's comp. int.	

Name **Movement**

Alert ID 0

Description Issued whenever the locator reports a change in position.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Alert ID	DH	0-1	16-bit uns. int.	0	
Block Length	DH	2-3	16-bit uns. int.	40	
X-Coordinate	DH	4-5	16-bit 2's comp. int.		
Y-Coordinate	DH	6-7	16-bit 2's comp. int.		
Button Vector	DH	8-39			(1)

Note

1. This field is a bit-vector in which the N'th bit specifies the state of the N'th logical button (see Figure 13 in the main body of this document). If a bit's value is 1, its logical button is pressed; otherwise it is released.

Name	**Button Pressed**
Alert ID	1
Description	Issued whenever a locator button changes from released to pressed.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Alert ID	DH	0-1	16-bit uns. int.	1	
Block Length	DH	2-3	16-bit uns. int.	41	
Active Button	DH	4	8-bit uns. int.		
X-Coordinate	DH	5-6	16-bit 2's comp. int.		
Y-Coordinate	DH	7-8	16-bit 2's comp. int.		
Button Vector	DH	9-40			(1)

Note

1. This field is a bit-vector in which the N'th bit specifies the state of the N'th logical button (see Figure 13 in the main body of this document). If a bit's value is 1, its logical button is pressed; otherwise it is released.

Name	**Button Released**
Alert ID	2
Description	Issued whenever a locator button changes from pressed to released.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Alert ID	DH	0-1	16-bit uns. int.	2	
Block Length	DH	2-3	16-bit uns. int.	41	
Active Button	DH	4	8-bit uns. int.		
X-Coordinate	DH	5-6	16-bit 2's comp. int.		
Y-Coordinate	DH	7-8	16-bit 2's comp. int.		
Button Vector	DH	9-40			(1)

Note

1. This field is a bit-vector in which the N'th bit specifies the state of the N'th logical button (see Figure 13 in the main body of this document). If a bit's value is 1, its logical button is pressed; otherwise it is released.

APPENDIX D

VIDEO/GRAPHICS OVERLAY SERVICES

Name **Services Query**

Service ID 2

Description Lists all services and alerts provided by the target device. Returns two bit-vectors, one describing services and one describing alerts. The N'th bit in each vector reflects support for the N'th service or alert. Allows an application to determine which extended services are supported by a particular device.

Block Format

Field Name	**Set By**[a]	**Byte #**	**Format**[b]	**Possible Values**	**Notes**
Service ID	A	0-1	16-bit uns. int.	2	
Block Length	A	2-3	16-bit uns. int.	15	
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy	
Request Vector Byte Length	DH	5	8-bit uns. int.		
Request Vector Address	DH	6-9	32-bit address to bit-vector		(1)
Alert Vector Byte Length	DH	10	8-bit uns. int.		
Alert Vector Address	DH	11-14	32-bit address to bit-vector		(1)

[a] Throughout Appendix D, this column indicates which program(s) set the specified field: A = application; RC = R&C program; DH = device handler.
[b] Throughout Appendix D, the abbreviations used in this column are: "uns. int." = unsigned integer; "2's comp. int." = two's complement integer.

Note 1. *Bits set to 1 indicate a supported service. Bits set to 0 reflect an* unsupported service.

Name **Set Alert Mask**

Service ID 3

Description Enables and disables alerts based on the contents of a bit-vector, called the alert mask. This mask has the same format as service 2's alert vector: The N'th bit in the mask corresponds with the N'th alert. If the bit is 1, the device handler will issue the alert. If the bit is 0, the device handler will not issue the alert. All alerts are disabled by default.

Block Format

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	3
Block Length	A	2-3	16-bit uns. int.	10
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy
Alert Mask Byte Length	A	5	8-bit uns. int.	
Alert Mask Address	A	6-9	32-bit address to bit-vector	

Name **Disable All Alerts**

Service ID 4

Description Disables all alerts.

Block Format

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	4
Block Length	A	2-3	16-bit uns. int.	5
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy

Name **Reset**

Service ID 5

Description Causes the overlay device's device handler to establish communications with its peripheral and to perform any hardware-specific initialization. After successful completion of this service, the graphic plane is turned on, the video plane is turned off, all logical colors are opaque, the current video source is source 0, and transparency is disabled.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	5	
Block Length	A	2-3	16-bit uns. int.	5	
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Hardware not responding	(1)

Note 1. Individual manufacturers may define additional error codes to indicate malfunctions specific to their hardware.

Name **Set Colors Transparent/Opaque**

Service ID 6

Description Turns transparency on or off for logical colors on the graphic plane by changing entries in the transparency palette.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	6	
Block Length	A	2-3	16-bit uns. int.	13	
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Hardware not responding 5 = Palette bound out of range 6 = Invalid transparency palette entry	
First Color	A	5-6	16-bit uns. int.		(1)
Last Color	A	7-8	16-bit uns. int.		(1)
Palette Address	A	9-12	32-bit address	0 = Transparent 255 = Opaque	(2)

Notes

1. Specifies the upper and lower bounds of a range of logical colors whose transparency palette entries will be changed by this service.

2. The address of an array of new transparency palette entries for the range of logical colors specified by the previous two fields. Each element of this array must be an 8-bit, unsigned integer whose value is either 0 or 255. The number of entries the array should contain equals Last Color - First Color + 1.

Name **Transparency Palette Enabled/Disabled**

Service ID 7

Description Enables and disables the transparency palette. When disabled, all colors are considered opaque.

Block Format

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	7
Block Length	A	2-3	16-bit uns. int.	6
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Hardware not responding
Enabled/ Disabled	A	5	8-bit uns. int.	0 = Disable transparency 1 = Enable transparency

Name **Select Video Input**

Service ID 8

Description Selects the video source to be displayed on the video plane.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	8	
Block Length	A	2-3	16-bit uns. int.	6	
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Hardware not responding 7 = Video source out of range	
Video Source	A	5	8-bit uns. int.		

Name	**Set Video Intensity On/Off**
Service ID	9
Description	Sets the vide‹ intensity to maximum (on) or minimum (off).
Block Format	

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	9
Block Length	A	2-3	16-bit uns. int.	6
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Hardware not responding
Video On/Off	A	5	8-bit uns. int.	255 = On 0 = Off

Name	**Set Graphic Intensity On/Off**
Service ID	10
Description	Sets the graphic intensity to maximum (on) or minimum (off).
Block Format	

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	10
Block Length	A	2-3	16-bit uns. int.	6
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Hardware not responding
Graphic On/Off	A	5	8-bit uns. int.	255 = On 0 = Off

Name	**Align Graphic Plane**
Service ID	11
Description	Shifts the position of the graphic plane relative to the video plane.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	11	
Block Length	A	2-3	16-bit uns. int.	9	
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Hardware not responding 8 = Horizontal shift out of range 9 = Vertical shift out of range	
Horizontal Shift	A	5-6	16-bit 2's comp. int.		(1)
Vertical Shift	A	7-8	16-bit 2's comp. int.		(2)

Notes

1. Specifies the number of pixels to shift the graphic plane horizontally relative to the video plane from its current position. A negative value specifies a shift to the left and a positive value specifies a shift to the right.
2. Specifies the number of pixels to shift the graphic plane vertically relative to the video plane from its current position. A negative value specifies a shift down and a positive value specifies a shift up.

Name	**Status Query**
Service ID	12
Description	Provides information about the current state of the overlay device.
Block Format	

Field Name	Set By	Byte #	Format	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	20	
Block Length	A	2-3	16-bit uns. int.	21	
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Hardware not responding 5 = Palette bound out of range	
Palette Size	DH	5-6	16-bit uns. int.		(1)
Video Sources	DH	7	8-bit uns. int.		(2)
Overlay Service	DH	8	8-bit uns. int.	1 = Available 0 = Not available	(3)
Graphic Plane Intensity	DH	9	8-bit uns. int.		
Video Plane Intensity	DH	10	8-bit uns. int.		
Dissolve Level	DH	11	8-bit uns. int.		
Trans-parency Palette	DH	12	8-bit uns. int.	1 = Enabled 0 = Disabled	
First Color	DH	13-14	16-bit uns. int.		(4)
Last Color	DH	15-16	16-bit uns. int.		(4)
Palette Address	DH	17-20	32-bit address		(5)

Notes

1. Returns the number of logical colors that can be displayed simultaneously on the graphic plane.
2. Returns the number of video sources available for display on the video plane.
3. Returns whether or not overlay services are available in the current graphic mode.
4. Specifies the upper and lower bounds of a range of logical colors whose current transparency palette entries will be returned by this service.
5. The address of an array of transparency palette entries for the range of logical colors specified by the previous two fields. Each element of this array returns an 8-bit, unsigned integer that specifies the current transparency palette entry for a logical color.

Name **Set Colors Translucent (Extended)**

Service ID 13

Description Sets the transparency palette entries for logical colors on the graphic plane. This extended service allows values other than 0 (transparent) and 255 (opaque).

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	13	
Block Length	A	2-3	16-bit uns. int.	13	
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Hardware not responding 5 = Palette bound out of range	
First Color	A	5-6	16-bit uns. int.		(1)
Last Color	A	7-8	16-bit uns. int.		(1)
Palette Address	A	9-12	32-bit address		(2)

Notes

1. Specifies the upper and lower bounds of a range of logical colors whose transparency palette entries will be changed by this service.
2. The address of an array of new transparency palette entries for the range of logical colors specified by the previous two fields. Each element of this array must be an 8-bit unsigned integer that specifies the transparency palette entry for a logical color, where 255 means opaque and 0 means transparent and values between specify a mixture of graphic and video.

Name **Set Video Intensity (Extended)**

Service ID 14

Description Sets the video plane intensity over a specified amount of time. This extended service allows values other than 0 (off) and 255 (on). During asynchronous operation, all other services operate as specified.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	14	
Block Length	A	2-3	16-bit uns. int.	9	
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Hardware not responding	
Video Intensity	A	5	8-bit uns. int.		
Duration	A	6-7	16-bit uns. int.		(1)
Sync/ Async	A	8	8-bit uns. int.	0 = Asynchronous 1 = Synchronous	(2)

Notes

1. Specifies the time, in seconds, during which the video plane will change from its current intensity to the new intensity. If the time specified is zero, the video plane is set to the new intensity immediately. If a non-zero time is specified, the video plane will change from its current intensity to the new intensity uniformly over the time specified.

2. Specifies whether this service will be executed synchronously or asynchronously. When executed asynchronously, alert 0, "Service Complete," is issued when the video plane is at the new intensity.

Name	**Set Graphic Intensity (Extended)**
Service ID	15
Description	Sets the graphic plane intensity over a specified amount of time. This extended service allows values other than 0 (off) and 255 (on). During asynchronous operation, all other services operate as specified.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	15	
Block Length	A	2-3	16-bit uns. int.	9	
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Hardware not responding	
Graphic Intensity	A	5	8-bit uns. int.		
Duration	A	6-7	16-bit uns. int.		(1)
Sync/ Async	A	8	8-bit uns. int.	0 = Asynchronous 1 = Synchronous	(2)

Notes

1. Specifies the time, in seconds, during which the graphic plane will change from its current intensity to the new intensity. If the time specified is zero, the graphic plane is set to the new intensity immediately. If a non-zero time is specified, the graphic plane will change from its current intensity to the new intensity uniformly over the time specified.

2. Specifies whether this service will be executed synchronously or asynchronously. When executed asynchronously, alert 0, "Service Complete," is issued when the graphic plane is at the new intensity.

Name **Set Dissolve (Extended)**

Service ID 16

Description Sets the dissolve level over a specified amount of time. During asynchronous operation, all other services operate as specified.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	16	
Block Length	A	2-3	16-bit uns. int.	9	
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Hardware not responding	
Dissolve Level	A	5	8-bit uns. int.		
Duration	A	6-7	16-bit uns. int.		(1)
Sync/ Async	A	8	8-bit uns. int.	0 = Asynchronous 1 = Synchronous	(2)

Notes

1. Specifies the time, in seconds, during which the dissolve level will change from its current level to the new level. If the time specified is zero, the new level is set immediately. If a non-zero time is specified, the level will change from its current level to the new level uniformly over the time specified.

2. Specifies whether this service will be executed synchronously or asynchronously. When executed asynchronously, alert 0, "Service Complete," is issued when the dissolve level is at its new value.

Name **Timed Service Completed**

Alert ID 0

Description Issued when an asynchronous, timed service has completed.

Block Format

Field Name	Set By	Byte #	Format	Possible Values
Alert ID	DH	0-1	16-bit uns. int.	0
Block Length	DH	2-3	16-bit uns. int.	6
ID of Completed Service	DH	4-5	8-bit uns. int.	14 = Set video intensity 15 = Set graphic intensity 16 = Set dissolve

Name **Graphic Plane Mode Changed**

Alert ID 1

Description Issued whenever the number of logical colors or the pixel resolution on the graphic plane changes because of a mode switch on the graphic device. This alert also informs the application whether or not the overlay device is capable of providing overlay services in the new graphic mode.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Alert ID	DH	0-1	16-bit uns. int.	1	
Block Length	DH	2-3	16-bit uns. int.	7	
Palette Size	DH	4-5	16-bit uns. int.		(1)
Overlay Service Availability	DH	6	8-bit uns. int.	1 = Available 0 = Not available	

Note 1. Returns the number of logical colors that can be displayed at one time on the graphic plane after the mode change.

APPENDIX E

AUDIO MANAGEMENT SERVICES

Name	**Services Query**
Service ID	2
Description	Lists all services and alerts provided by the target device. Returns two bit-vectors, one describing services and one describing alerts. The N'th bit in each vector reflects support for the N'th service or alert. Allows an application to determine which extended services are supported by a particular device.

Block Format

Field Name	Set By[a]	Byte #	Format[b]	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	2	
Block Length	A	2-3	16-bit uns. int.	15	
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy	
Request Vector Byte Length	DH	5	8-bit uns. int.		
Request Vector Address	DH	6-9	32-bit address to bit-vector		(1)
Alert Vector Byte Length	DH	10	8-bit uns. int.		
Alert Vector Address	DH	11-14	32-bit address to bit-vector		(1)

[a] Throughout Appendix E, this column indicates which program(s) set the specified field: A = application; RC = R&C program; DH = device handler.
[b] Throughout Appendix E, the abbreviation "uns. int." = unsigned integer.

Note

1. Bits set to 1 indicate a supported service. Bits set to 0 reflect an unsupported service.

Name **Set Alert Mask**

Service ID 3

Description Enables and disables alerts based on the contents of a bit-vector, called the alert mask. This mask has the same format as service 2's alert vector. Included for future services. No alerts are currently specified for this device.

Block Format

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	3
Block Length	A	2-3	16-bit uns. int.	10
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy
Alert Mask Byte Length	A	5	8-bit uns. int.	
Alert Mask Address	A	6-9	32-bit address to bit-vector	

Name **Disable All Alerts**

Service ID 4

Description Disables all alerts.. Included for future services. No alerts are currently specified for this device.

Block Format

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	4
Block Length	A	2-3	16-bit uns. int.	5
Status	RC/ DH	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy

Name	**Audio Management Attributes**
Service ID	5
Description	Returns information about the configuration of the audio management device.

Block Format

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	5
Block Length	A	2-3	16-bit uns. int.	7
Status	DH/RC	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Hardware not responding
Sources Available	DH	5	8-bit uns. int.	
Outputs Available	DH	6	8-bit uns. int.	

Name	**Audio Source On/Off**
Service ID	6
Description	Turns the selected audio source on or off.
Block Format	

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	6
Block Length	A	2-3	16-bit uns. int.	7
Status	DH/ RC	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Hardware not responding 5 = Source out of range
Source	A	5	8-bit uns. int.	
Source On/Off	A	6	8-bit uns. int.	0 = Off 1 = On

Name	**Audio Output On/Off**
Service ID	7
Description	Turns the selected audio output on or off.
Block Format	

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	7
Block Length	A	2-3	16-bit uns. int.	7
Status	DH/ RC	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Hardware not responding 6 = Output out of range
Output	A	5	8-bit uns. int.	
Output On/Off	A	6	8-bit uns. int.	0 = Off 1 = On

Name	**Set Source Level**
Service ID	8
Description	Sets the selected audio source's level.
Block Format	

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	8
Block Length	A	2-3	16-bit uns. int.	8
Status	DH/ RC	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Hardware not responding 5 = Source out of range 6 = Output out of range
Source	A	5	8-bit uns. int.	
Output	A	6	8-bit uns. int.	
Level	A	7	8-bit uns. int.	

Name	**Set Output Level**
Service ID	9
Description	Sets the selected audio output's level.
Block Format	

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	9
Block Length	A	2-3	16-bit uns. int.	7
Status	DH/ RC	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Hardware not responding 6 = Output out of range
Output	A	5	8-bit uns. int.	
Level	A	6	8-bit uns. int.	

Name	**Query Source State**
Service ID	10
Description	Returns information about the current state of the specified audio source.
Block Format	

Field Name	Set By	Byte #	Format	Possible Values
Service ID	A	0-1	16-bit uns. int.	10
Block Length	A	2-3	16-bit uns. int.	7
Status	DH/ RC	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Hardware not responding 5 = Source out of range
Source	A	5	8-bit uns. int.	
Source On/Off	DH	6	8-bit uns. int.	0 = Off 1 = On

Name	**Query Output State**
Service ID	11
Description	Returns information about the current state of the specified audio output.

Block Format

Field Name	Set By	Byte #	Format	Possible Values	Notes
Service ID	A	0-1	16-bit uns. int.	11	
Block Length	A	2-3	16-bit uns. int.	13	
Status	DH/ RC	4	8-bit uns. int.	0 = Service successful 1 = Unknown error 2 = Device not available 3 = Device handler busy 4 = Hardware not responding 6 = Output out of range	
Output	A	5	8-bit uns. int.		
Level	DH	6	8-bit uns. int.		
Output On/Off	DH	7	8-bit uns. int.	0 = Off 1 = On	
Source Levels Array Length	DH	8	8-bit uns. int.		
Source Levels Array	DH	9-12	32-bit address		(1)

Note

1. Returns the address of an array containing the source level values for the mixture produced by the selected output.

Distribution List

Distribution:
Assistant Secretary of Defense (Force Management and Personnel)
Deputy Under Secretary of Defense for Research and Engineering (Research and Advanced Technology)
Director, Total Force Training and Education (OP-11)
Director, Aviation Training Systems Program Coordinator (PMA-205)
Commanding Officer, Naval Training Systems Center
Defense Technical Information Center (DTIC) (2)

Copy to:
Deputy Chief of Naval Operations (MP&T) (OP-01)
Assistant for Planning and Technical Development (OP-01B2)
Head, Training and Education Assessment (OP-11B1)
Director, Total Force Information System Management (OP-16)
Director, Submarine Manpower and Training Requirements (OP-29)
Director, Command Surface Warfare Manpower and Training Requirements (OP-39)
Director, Air ASW Training (OP594)
Assistant for Manpower, Personnel, and Training (OP-983D)
Commander, Naval Sea Systems Command (PMS 350)
Commander, Naval Sea Systems Command (PMS 396)
Commander, Naval Sea Systems Command (CEL-MP)
Director, Strategic Systems Project (SP-15)
Commanding Officer, New London Laboratory, Naval Underwater Systems Center (Code 33A)
Commanding Officer, New London Laboratory, Naval Underwater Systems Center (Code 3333)
Naval Training Systems Center, Technical Library (5)
Naval Training Systems Center (Code 10), (Code N-1), (Code 7)
Director, Office of Naval Research (OCNR-10)
Chief Scientist, Office of Naval Technology (OCNR-20T)
Chief of Naval Education and Training (Code 00)
Director, Training Technology (Code N-54)
Commanding Officer, Naval Education and Training Program Management Support Activity (Code 03) (2)
Commanding Officer, Naval Education and Training Program Management Support Activity (Code 04) (2)
Chief of Naval Technical Training (Code 00) (2)
Commander, Naval Military Personnel Command (NMPC-00/PERS-1)
Naval Military Personnel Command, Library (Code NMPC-013D)
Commanding Officer, Naval Health Sciences Education and Training Command, Bethesda, MD
Commander, Naval Reserve Force, New Orleans, LA
Commandant of the Marine Corps, Commanding General, Marine Corps Research and Development and Acquisition Command
Commander, U.S. ARI, Behavioral and Social Sciences, Alexandria, VA (PERTI-POT-I)
Technical Director, U.S. ARI, Behavioral and Social Sciences, Alexandria, VA (PERI-ZT)

Commander, Air Force Human Resources Laboratory, Brooks Air Force Base, TX
Scientific and Technical Information (STINFO) Office
TSRL/Technical Library (FL 2870)
Program Manager, Life Sciences Directorate, Bolling Air Force Base, DC (AFOSR/NL)
Commander, OPSTNGDIV Air Force Human Resources Laboratory, Williams Air Force Base, AZ (AFHRL/OT)
Commander, Air Force Human Resources Laboratory, Wright-Patterson Air Force Base, OH, Logistics and Human Factors Division (AFHRL/LRS-TDC)
Director of Training, Office of Civilian Personnel Management
Superintendent, Naval Postgraduate School
Director of Research, U.S. Naval Academy
Center for Naval Analyses